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Haec Credimus

For in six days the Lord made heaven and earth, the sea, and all that in them is, and rested on the seventh.—Exodus 20:11

Letter from the Editor

It is my pleasure to serve as the new editor for the *Creation Research Society Quarterly*. The ranks of those that have preceded me reads almost like a "who's who" in creation science. They have collectively worked over the years to make the Quarterly one of the premier creation journals. I will make every attempt to keep that tradition, and with the Lord's grace, perhaps even enhance the Quarterly's reputation. However, I am now also the new director for the Society's Van Andel Creation Research Center. So it is uncertain how long I will remain as the Quarterly's editor. Regardless of the time frame, I will diligently seek to keep the Quarterly at the cutting edge of creation science. This will also include some changes, such as a greater emphasis on electronic submissions and a more detailed set of instructions for authors (see back of this issue). I would ask all those considering submitting a manuscript to the Quarterly to carefully read these instructions. Dr. Lane Lester does a superb job as the Quarterly's managing editor, and submissions that closely follow these guidelines help make his job easier and enable a much faster turnaround from submission to publication.

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Book Review

Love Your God With All Your Mind by J.P. Moreland
Navpress, Colorado Springs 1997, 249 pages, $14.

J.P. Moreland is professor of philosophy at Talbot Seminary, La Mirada, CA. He has authored a dozen books, several of which discuss creation (DeYoung, 1995). This book challenges the Christian Church to reclaim its heritage of scholarship and intellectual leadership. One is reminded of the earliest colleges and universities in America which were founded to train pastors and missionaries. Moreland laments the "empty self," the all-too-common modern life which remains immature, self-centered, passive, and devoid of deep thinking (p. 92). The wastelands of television and casinos provide examples.

Regarding origins, Moreland favors progressive creation (p. 107). This position accepts the big bang and a long history of animal death and extinction before Adam arrived. Moreland feels a bit uneasy: "I lean toward the view that the days of Genesis are vast periods of time…But about two days of the week I flip-flop and accept the literal view…I'm about sixty-forty in favor of the old-earth position" (p. 107). The author's honesty is commendable. However, his fence-sitting suggests that Moreland has not processed the implications of deep time (DeYoung, 2002).

Moreland's call for a higher level of Christian scholarship and thinking is much needed. His analysis of scientism (p. 114), logical fallacies (p. 121), and worship (p. 155) is helpful. Moreland is evidential in his apologetics (p. 137), and he strongly supports the Intelligent Design movement. An appendix contains 30 pages of "intellectual resources" including Bible-science. There is no mention of the CRS, ICR, or AIG. The book has no index.

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DeYoung, Don. 2002. Theological implications of deep time *CRSQ* 39(1):22–24.

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Are Paleosols Really Ancient Soils?

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Abstract

Paleosols, or fossil soils, are being reported by uniformitarian geologists in increasing numbers. This is to be expected, since the "deep time" of the traditional view of earth history would naturally result in the burial and preservation of many soils. However, not only do uniformitarian assumptions guide the investigation of paleosols, but their very definition is unscientific, a "mixed question." This paper addresses the question of whether paleosols can exist, how they may be identified, and how diluvialists should approach the investigation of alleged paleosols.

Introduction

Many define a paleosol simply as a buried soil (Bates and Jackson, 1984, p. 367), though disputes among paleopedologists about the definition of a paleosol (Froede, 1998, p. 26) are very easy to find. We understand a paleosol to be a "fossil soil," i.e. a soil that has been preserved in the geologic record or buried deeply enough that it is no longer subject to soil forming processes. This implies recognizable soil horizons. However, paleosols are more commonly *inferred* from the rock record. According to some, paleosols can even exist on the surface and be inactive—as if that were possible to determine (Retallack, 1990, p. 9)! Paleosols have been widely recognized in the "Quaternary" for over 100 years (Mahaney, 1978).

With the exception of underclays, paleosols were long considered rare to nonexistent in pre-"Quaternary" sedimentary rocks. Then in the 1960s, the "renaissance" began (Retallack, 1990, pp. 6–7). Ever since, claims of paleosols have become much more abundant (Retallack, 1988, p. 11; Kraus, 1999). It seems one can hardly read an article on strata or sedimentary rocks without reference to a paleosol. Retallack (1983) even managed to discover eighty-seven paleosols in a 143-meter stratigraphic section in Badlands National Park, South Dakota! From a uniformitarian perspective of long ages, paleosols really should be common in "terrestrial" deposits:

> In view of the principle of uniformitarianism as applied to present-day alluvial sequences, we believe that fluvial rocks that do not contain pedogenic features are probably exceptional (Bown and Kraus, 1981).

Paleopedology[1] is the basis for much modern research in "Quaternary" geology, and is certainly foundational to paleoclimatology and paleogeography. Paleosols have been used to distinguish between various glaciations, especially the four "ice ages" in the Midwest of the United States (Leighton and MacClintock, 1961; Retallack, 1990, pp. 4–5) and two or more "ice ages" in the Rocky Mountains of the United States (Hall and Shroba, 1993; 1995). These paleosols are assumed to represent interglacial weathering between glacial ages (Cioppa et al., 1995; Horberg, 1956; Karlstrom, 1982; 1987; 1988; 1990; 1991). That these paleosols are often absent or dubious and not essential to the multiple glaciation time schemes is evident from some of the literature (Lemke et al., 1965). In recent years, some paleopedologic interpretations have run aground on physical evidences or the preference of many researchers for deep-sea cores or other methods (Froede, 1998, p. 23). Nonetheless, paleopedology remains an important discipline in stratigraphy (Klevberg, 2000a), and it probably will remain so for the foreseeable future.

Implications of Paleosols

Modern soils, as well as "Quaternary paleosols," are assumed to form over long periods of time: "The time spans required to form soils are thousands to millions of years" (Retallack, 1990, p. 13). Paleosols are not only used to infer long periods of time, but also to interpret ancient environments (Retallack, 1990, p. 115). By comparing the properties of a paleosol to a modern soil, uniformitarian scientists infer the ancient environment: "If a paleosol is very similar to a modern soil, then perhaps environments similar to those that formed the soil can be inferred for the paleosol" (Retallack, 1993, p. 1636). Although some researchers urge caution in using paleosols to infer paleoclimate, most still deduce the mean annual temperature and precipitation during "paleosol development" (Kraus,

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[1] This and other important terms are included in the glossary near the end of this paper.

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1999). Some diluvialists have incorporated paleosol interpretations and paleoclimatic interpretations into their own research (Williams et al., 1995; Froede, 1996), as have neocuvierists (Robinson, 1996, p. 55).

While the diluvial geologic paradigm (DGP) can accommodate the theoretical concept of paleosols (depending on how they are defined), they are certainly not expected to be common. The establishment geologic paradigm (EGP), on the other hand, virtually demands ubiquitous paleosols because of the assumptions of gradualism, localized catastrophes, and vast periods of time for earth history (Froede, 1998, pp. 27–28). Thus, the proliferation of paleosols in the literature in recent decades is predictable. There is no doubt that the traditional understanding of paleosols conflicts with the Biblical timescale of thousands of years for the age of the earth and a global flood that laid down practically all the sedimentary rocks that contain “paleosols.” How can these “paleosols” represent so much time? Are they really buried soils? Can one really estimate the paleoclimate from a paleosol? Are there alternative interpretations for the features that are considered indicative of paleosols by uniformitarian scientists?

Can Paleosols Exist?

Because the concept of a paleosol generally represents an event that happened in the prehistoric past, the study of paleosols is really a mixed question. Fields in which knowledge may be properly acquired from more than one source or using more than one method require proper attention to their differences lest false conclusions be reached (Ancil, 1985; Brand, 1985; 1996; Frangos, 1991; Plantinga, 1997a, p. 23; Reed, 2001). These interdisciplinary questions are sometimes termed “mixed questions” (Adler, 1965). Historical geology is a field that deals with mixed questions, principally history and science (Klevberg, 1999, pp. 75–76; Morris, 1984, p. 302; Reed 1996a; 1996b; Reed and Woodmorappe, 2002). Thus, how one interprets the layers in question depends upon one’s view of the past.

The historical part of the mixed question is the part that existed in the past. The EGP approach to natural history can be generalized as an ad hoc scenario based on naturalistic presuppositions (Morris, 1984; Reed, 2000, 2001). Assertions about past events or denials of the same are largely outgrowths of the religious conviction of evolution tempered more or less by scientific constraints. The DGP approach can be generalized as a natural history based principally on the Bible with lesser contributions from other historic sources and with extrapolations tempered by scientific constraints. If, on the other hand, one must depend only on technical inferences without historical sources, the number of possibilities is limitless, and science may be incapable of disproving any of the concocted scenarios. Thus, it should be evident that the EGP possesses more degrees of freedom from an historical perspective and is therefore less likely, on a purely probabilistic basis, to arrive at “what actually happened.” This part of the mixed question is clearly not neutral religiously or philosophically (views of natural history and theology are intrinsically related).

The scientific part of the mixed question is the part that exists in the present. In theory, the EGP and DGP approaches to the scientific part of the mixed question should be identical; unfortunately, because of a lack of understanding of mixed questions or a lack of commitment to the scientific method, this is seldom the case. EGP adherents frequently invoke radiometric dating and other methods without distinguishing data from inferences. DGP adherents must avoid the error of confusing historical assumptions with field data if scientifically meaningful work is to be accomplished. In regard to possible paleosols, this requires careful attention to properties that may distinguish soil-forming processes from other weathering processes and recognition of the tentative nature of any natural history reconstruction.

Do Paleosols Exist?

Since soils have been buried by various natural phenomena in historic times, we can safely assert that *if paleosols are defined as buried soil horizons in which soil forming processes are no longer operative, paleosols do exist*. Figure 1 is a photograph of a buried soil exposed in the bank of Cottonwood Creek, Fergus County, Montana. Note that while the A horizon has been somewhat disturbed, it is distinct and well preserved beneath slightly less than one meter of flood-deposited material. A new soil is forming in the flood alluvium, complete with a new A horizon. Because the annual average depth of wetting at this site is deeper than the buried A horizon, the pre-Flood soil is merely a buried soil and not a paleosol. Figure 2 shows the Goertzen homestead near Hodgeville, Saskatchewan, Canada. During the Dust Bowl, approximately a meter of eolian deposits buried the pre-1930s soil. As shown by Figure 3, eolian transport during the Dust Bowl was often dramatic (Lauber, 1963). Climatic changes and improvements in agricultural practices have resulted in considerable soil stabilization since the 1930s, and soil forming processes are active in the eolian material indicated in Figure 2. Although the pre-1930s soil is now buried, it is not certain whether it qualifies as a paleosol. If the average annual wetting depth is less than one meter, it would constitute a paleosol, since it would be deeper than the operative depth of soil-forming processes. It would be necessary to excavate a test pit to determine this. If a combination of permeability and microclimate (e.g. snow accumulation on a shaded lee slope or behind vegetation) enable the wet-

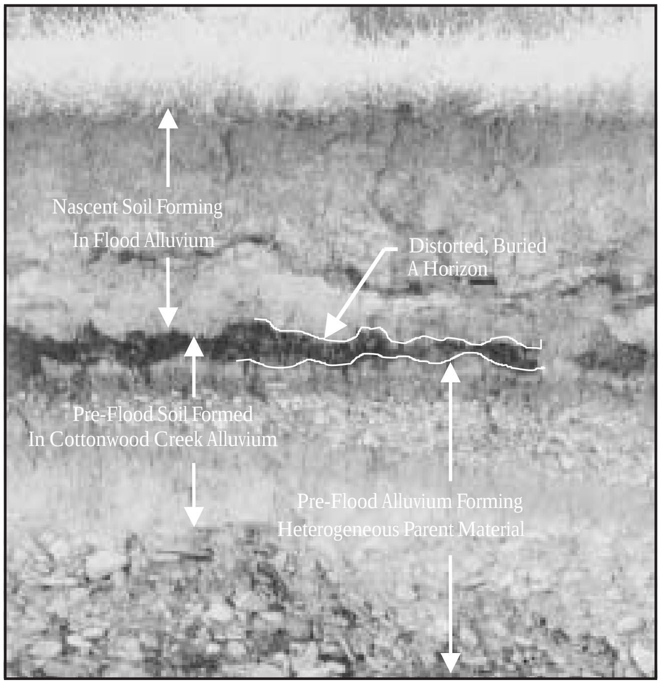

Figure 1. Buried soil in flood plain of Cottonwood Creek, Fergus County, Montana. Although slightly disturbed, the A horizon has been completely preserved. U.S.D.A. photograph.

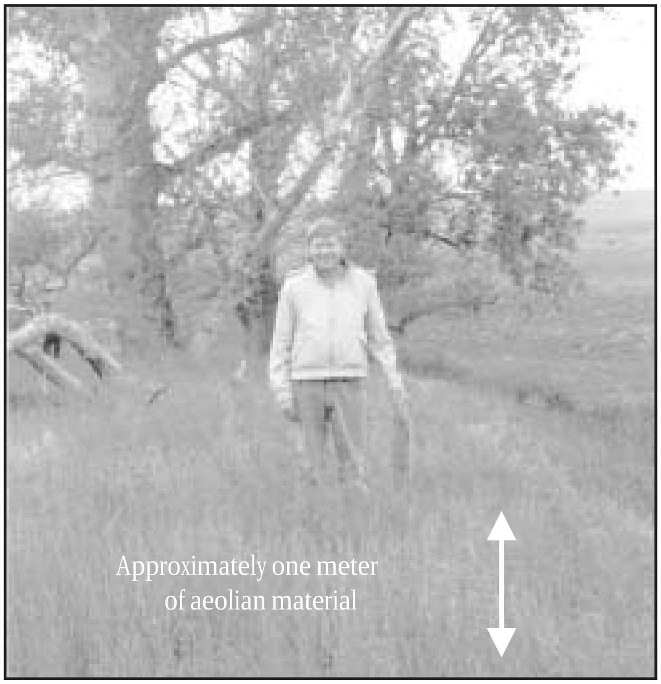

Figure 2. Goertzen Homestead, near Hodgeville, Saskatchewan. Aeolian material during the Dust Bowl buried soil around the fence line to a depth of up to one meter.

Figure 3. Springfield, Colorado, in 1934. Photograph courtesy Cecil and Lynn Walborn.

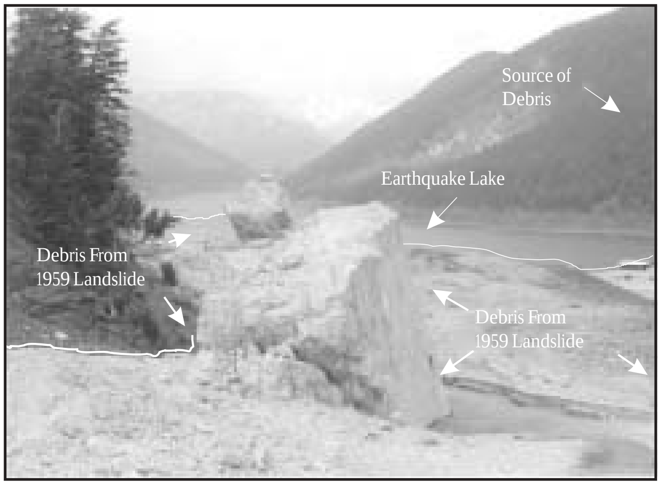

Figure 4. A 1995 photograph of the Hebgen Lake Earthquake slide in southwestern Montana which formed Earthquake Lake. Landslide debris from the other side of the valley moved up the slope to bury the pre-1959 soil, forming a paleosol.

ting depth to extend deeper than one meter, it would be merely a buried soil and not a paleosol. Similarly, if climate change results in increased depth of soil formation, a paleosol can be destroyed. Figure 4 shows the lee mountainside covered by the Hebgen Lake Earthquake slide in Montana. The pre-1959 soil is at least several meters beneath the present ground surface, too deep for most soil-forming mechanisms to be operative and too deep to act as a rooting medium for nearly all plants, and is therefore a paleosol. Many other examples exist. Volcanic eruptions, debris flows, or other events have buried soils well beyond the reach of soil-forming processes, forming paleosols.

Nonetheless, since the vast majority of alleged paleosols are prehistoric deposits, the question is not so easily answered in many cases. Based on recognition of the mixed nature of the question, one should realize that there is no "yes" or "no" answer for most of these deposits. The scientific method can, however, be employed to disprove many inferences in individual cases. Such applications of the scientific method require physical data and diagnostic properties. Froede (1998, p. 25) recognized this need for data:

> Uniformitarians state that soils have existed on earth for hundreds of millions of years, with some

surviving into the present due to burial and preservation. This interpretation should be supported by the physical evidence (i.e. paleosols) if it is to be accepted.

Recognizing Soil Profiles

Many earth materials form horizontal or subhorizontal layers, but not all of these represent soil profiles. Soil profiles show specific characteristics resulting from soil-forming processes (Klevberg and Bandy, 2003a). These characteristics are often specific to individual horizons and can be observed upon close examination of undisturbed samples from the horizons. Since diagenesis (post-depositional changes, such as lithification) can be considered a form of "disturbance," diagenesis may destroy these diagnostic properties. The horizons also assume a particular order if the sequence of strata actually represents a soil profile. This order is shown in Table I. Although some of the horizons could be missing in a paleosol, those present will be in the order shown in the table.

Distinguishing Paleosols

Soils can appear structureless to the non-soil scientist. However, as described above, they do possess structure; modern soils have definite soil horizons where the soil changes composition with depth due to soil-forming processes. Paleosols (as we have defined them here), in contrast with modern soils, have been buried and hence have undergone some degree of compaction and diagenesis. Although often subject to significant alteration, supposedly they can still be distinguished from other sedimentary layers. According to establishment researchers, paleosols are recognized in the field by three main features: 1) root traces, 2) soil horizons, and 3) soil structures (Retallack, 1990, p. 20). Important distinguishing characteristics of paleosols and problems with the paleosol interpretation or alternative explanations associated with each criterion are summarized in Table II.

Trace Fossils

Retallack (1988, p. 21, 22) believes that root traces *alone* are diagnostic of a paleosol. However, he admits that it is sometimes difficult to distinguish between a "root trace," a "burrow" and a gas escape structure (Retallack, 1990, p. 21, 22). Trace fossils may be classified using relatively scientific (i.e., descriptive) terminology, e.g. *Skolithos*, *Zoophycos*, *Ophiomorpha* (Tucker, 1990, pp. 75–79). These may then be interpreted to represent evidence of specific organisms, interpretations not always free from equivocation (Woodmorappe, 2002). If one feels confident about his inference about the identity of the organism forming the trace fossil, he may then assume that the conditions at the time of formation were "normal" conditions and not catastrophic, and that the trace fossils are indica-

Table I. Soil Horizon Descriptions.

	Horizon	Description
Surface of Soil ▸	O horizon	An O horizon is considered a horizon dominated by organic material in various stages of decomposition. Little or no mineral material is present in this horizon.
	A horizon	The A horizon is a mineral horizon that occurs either at the soil surface or directly below an O horizon. (Soil Survey Manual 1993). This horizon typically is enriched with some organic material that causes a darkening of the horizon.
	E horizon	The E horizon is a mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these (cf. *Soil Survey Manual*, 1993). This horizon is highly leached and tends to be a very light gray to white color with little or no organic matter present.
◂ Base of Solum	B horizon	The B horizon is a subsurface horizon that, if present, is found below an A and/or E horizon. It shows one or more of the following features (cf. *Soil Survey Manual*, 1993): • illuvial concentration of silicate clay, iron, aluminum, humus, carbonates, gypsum, or silica • evidence of removal of carbonates • residual concentrations of sesquioxides • coatings of sesquioxides that make the horizon different in color from adjacent horizons • granular, blocky, or prismatic structure; or • brittleness.
	C horizon	The C horizon is little affected by pedogenic processes and lacks properties of O, A, E, B horizons (cf. *Soil Survey Manual*, 1993).
	R horizon	The R horizon is hard bedrock.

Table II. Distinguishing criteria for paleosol identification.

Criterion	EGP Interpretation	Alternative Processes
Trace fossils	Roots indicate growth position; burrows usually represent ordinary conditions.	"Trace fossils" may be evulsion structures; burrows may not indicate ordinary conditions (including escape burrows); root debris may have been simply buried, often upright.
Contrasting Horizons ("Profile")	Soil profile development has been preserved as a paleosol.	Mineralogic or sedimentologic stratification may produce horizons, as may nonpedogenic weathering processes.
Clay-Rich Horizons	Clay-rich horizons are indicative of illuviation and diagnostic of pedogenesis.	Clay-rich horizons may be syndepositional, hydrothermal, or due to diagenetic epigenesis.
Carbonate Horizons	Calcic or petrocalcic horizons are indicative of soil horizon formed in arid or semi arid climate.	Carbonate may be syndepositional or deposited by ground water.
Oxidation	Oxidation is indicative of surficial weathering in the zone of soil formation.	Oxidation may be syndepositional or diagenetic rather than pedogenic.
Underclays	Underclays represent soil in which forest grew or beneath swamp which was source of organic material for coal formation.	Underclays result from typical hydrodynamic sedimentation effects (cyclothems, fining upward sequences); most coals are allochthonous, not

tive of soil-dwelling organisms. This, as all diluvialists will immediately recognize, is not a good assumption. Trace fossils may represent escape routes of organisms in danger of burial rather than dwelling or feeding burrows, or may consist of casts of root fragments buried in diluvial sediments rather than preserved in growth position. Evulsion structures or other physical phenomena may easily be misinterpreted as trace fossils (Tucker, 1990, p. 62). Far from being diagnostic, the trace fossil criterion for paleosol identification is highly equivocal.

Soil horizons

One of the diagnostic criteria of an altered "soil" is a sharply truncated upper horizon and a gradational lower horizon (Retallack, 1990, p. 30). The truncated upper horizon usually means that the organic enriched A horizon is missing (Birkeland, 1984, p. 33; Boardman, 1985, p. 71), leaving behind a clay layer, a calcium carbonate layer, a red layer, etc. These are *inferred* to be fossil soil horizons. However, it is the A horizon that would most readily identify a layer as a paleosol. So we are left with other equivocal variables in determining whether certain strata represent a paleosol. Thus, "soil profiles" identified as paleosols require skepticism. Since "paleosols" are commonly missing the A horizon, they are often just a clay layer or a "weathered layer" (Retallack, 1990, pp. 15, 126). As shown in Figure 1, preservation of the A horizon should not be unusual. Diagenetic processes may result in formation of lignite or some other carboniferous horizon, but complete absence of the A horizon makes a paleosol claim suspect. Any alleged paleosol should be scrutinized to see to what extent it corresponds to the sequence illustrated in Table I.

Paleosol literature often focuses on the inferred B horizon. The "B horizon" is not only used to infer the presence of a paleosol, but often the amount of time it represents based on the "degree of development":

> The degree of development of a soil or paleosol is evaluated by the clayeyness of the B horizon and its type of clay, thickness of the B horizon, and the presence and strength of clayey structures, colors, and nodules… (Bestland, 1997, p. 848).

Development of B_t or other B horizons does not represent just a time factor; parent material, topography, and climate (probably even biology) have a strong influence on its formation (Klevberg and Bandy, 2003a). Depressional potholes in glacial till are a good example. These soils have thick, high clay content B_t horizons. The surrounding soils have B_t horizons that are not as thick and do not have as much clay even though they came from the same parent material, thus indicating that initial conditions, not time, must be primarily responsible for this difference.

Soils with clay enriched horizons are common. These horizons typically have formed from clays leaching from surface horizons (eluviation) and being deposited in underlying horizons (illuviation). They may also have formed from different parent materials being deposited on top of one another. Clay films on ped surfaces can usually be used to differentiate between the two situations. Illuvial movement of clays into lower horizons should have clay films present on ped surfaces. Clay translocation can occur much more rapidly than is commonly assumed (Klevberg and Bandy, 2003b).

Carbonate horizons (often called caliche) do, of course, form pedogenically. Carbonate horizons are common in areas with dry climates where leaching does not occur beyond the depth of the solum. The carbonate horizons form when $CaCO_3$ is leached deeper into the solum by water to the point where the average annual wetting depth of the soil occurs. Most soils in arid and semiarid areas have a carbonate enriched horizon. Soil scientists call these calcic horizons (petrocalcic horizons or sometimes "calcrete" if cemented) when they are encountered in soils. Geologists utilize a variety of descriptive terms (e.g. lime-cemented conglomerate, carbonaceous sandstone, marl) to describe carbonate-dominated geologic units. Outside an actual soil profile (i.e., modern soil), *petrocalcic horizon* is a genetic term, revealing its mixed question nature.

Strata or horizons cemented by calcium carbonate are frequently cited as evidence for paleosols. While calcium carbonate enriched horizons commonly occur in modern soils in arid climates, pedogenesis is only one potential source for calcium carbonate in a geologic formation. Petrocalcic horizons typically form from $CaCO_3$ in the ground water. As the water evaporates or is used by plants, the $CaCO_3$ is deposited within the soil pores, plugging the pores and cementing the soil particles together. This process is observed in soils today, and evidence of petrocalcic horizons is described in some soil series. However, carbonate may also be supplied by ground water, or it may be syndepositional. Some deposits may have had complex histories with more than one source of carbonate. B_k horizons in extant soils are not usually cemented.

Oxidation occurs in most soils regardless of degree of weathering or depth of horizons. Reduction only occurs when anaerobic conditions are present along with the following:

- A food source,
- Temperatures above 5°C,
- Anaerobic bacteria present, and
- Saturated soils

Where these conditions do not exist, oxidation takes place. Oxidized minerals are often found where hydrothermal alteration or other geologic processes have occurred. Many alleged paleosols are more readily explained by hydrothermal and metamorphic processes (Palmer, Phillips, and McCarthy, 1989).

Underclays are probably the most commonly invoked "paleosols" of pre-"Quaternary" rocks, at least in the past (Froede, 1998, p. 24). These are clay strata, often relatively structureless, subjacent to coal beds. The EGP traditional explanation for coal formation is peat accumulation in swamps, and the underclay is supposedly the C horizon of a histosol (Klevberg and Bandy, 2003a). However, soil profile development is not observed in underclays (Scheven, 1996), and the swamp (autochthonous) theory for coal formation has been widely refuted (Coffin, 1968; 1969; Rupke, 1969; Snelling and Mackay, 1984; Woodmorappe, 1999, pp. 215, 216). "Underclays" often occur in cyclothems, suggesting their formation was part of a rapid depositional process (Berthault, 1986; Woodmorappe, 1999, pp. 199–220).

Soil Structures

Of special interest in the study of paleosols are peds (soil aggregates), cutans (the surfaces of peds), glaebules (aggregates of distinctive composition), and mineral crystals such as gypsum. Unfortunately, peds and cutans are hard to identify in paleosols because of compaction and diagenesis (Retallack, 1990, p. 38, 40). Glaebules are not diagnostic of paleosols, since they can form in other types of sediments (Retallack, 1990, p. 46). Crystals can, of course, form in many different environments and hence are not diagnostic of a paleosol either (Retallack, 1990, p. 47).

Glaebules could have arisen from any process or combination of processes capable of producing inclusions within the soil matrix that are recognizably different. To assume isotropy for parent material, epigenetic processes, or the history of many soils is grossly simplistic at best (Klevberg and Bandy, 2003a). The complexity of pedogenesis rather suggests that glaebules unrelated to paleosols should be common in many soils.

Physil species sometimes considered diagnostic of soil-forming processes have been observed in circumstances indicative of syngenetic or diagenetic processes (Klevberg and Bandy, 2003b). Although they may be useful in testing various pedogenesis scenarios, they have multiple possible sources of origin and are not diagnostic of a paleosol. Physils can actually be diagnostic of parent material, not pedogenic history (Birkeland, 1974, p. 141).

Froede (1998, pp. 25, 26) pointed out the general difficulty facing paleopedologists in distinguishing paleosols in the geologic record:

> Presently, there is no standardized technique by which paleosols can be defined. Some investigators use modern soil science methods while others have developed their own schemes.... In many cases paleopedologists claim to be able to identify multiple buried soil horizons.... The identification of the purported paleosol horizons is based on a variety of soil classification techniques which allow for a highly interpretative framework.... This suggests an element of subjectivity involved in the "science."

We do well to heed the warning of James, Mack, and Monger (1993, p. 1637):

> …many paleosols do not possess adequate characteristics to allow for proper classification at the order level following Soil Taxonomy. This is a fact.

Diagnostic criteria for paleosols are lacking, and perhaps because of this, methodology is often scientifically weak (White, 1998).

Rates of Soil Formation

Moderns soils, and by extension paleosols, are *assumed* to form over long periods of time. One reason for this time scale is that "Quaternary" soils have been used as analogs for the time of development of paleosols (Retallack, 1990, p. 13). Since the "Quaternary" is considered to be the past two million years or so, it is no wonder that long ages are *automatically* built into "paleosols." Thus, the postulated time for soil formation is simply a uniformitarian outgrowth of their hugely inflated time scale and displays gross negligence in accommodating the mixed question nature of the problem (Klevberg and Bandy, 2003a; 2003b).

The assertion of long ages for soil development comes in spite of modern soil forming rates being *unknown* (Boardman, 1985). Birkeland (1984, pp. 118, 119) admits, "It should be pointed out that it is very difficult to determine soil processes because few actual measurements can or have been made." Soils can form quickly under the right conditions. For instance, a 24 cm thick soil (an andisol, 10 inches thick) with distinct horizons formed within seventy-four years on Kodiak Island, Alaska (Ping, 2000, p. 1265), and a 36 cm (14 in) thick andisol formed in just forty-five years on the volcanic ash deposited from the eruption of Krakatau (Leet and Judson, 1965, pp. 83–84). Other soil orders, though not typically formed as quickly as andisols, may take much less time to form than commonly asserted, and some may be partial relicts of geologic processes (Klevberg and Bandy, 2003a; 2003b). Soil formation in the limestone of Kamenetz Fortress in Ukraine in a xeric moisture regime (in a region dominated by mollisols; cf. Figure 1 in Klevberg and Bandy, 2003b) amounted to 30 cm (12 in) in 230 years, and comparable rates of soil formation have been observed in sand dunes and moraines in even relatively cool and dry climates (Jenny, 1941, pp. 35–44). Caliche may form quickly enough to clog drain pipes (Hunt, 1972, p. 45). While pedogenesis is very complex (Klevberg and Bandy, 2003a) and rates often difficult to estimate, observed rates of formation for many soils have been much faster than traditionally assumed (Burykin and Zasorinal, 1989; Klevberg and Bandy, 2003b).

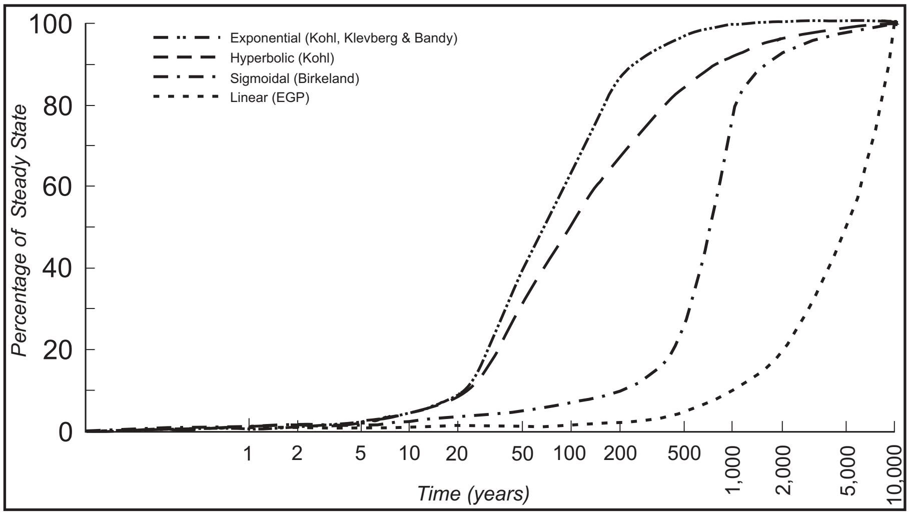

Figure 5. Disparate models for rates of pedogenesis. The term "steady state" refers to dynamic equilibrium of soil-forming processes with environmental factors (Klevberg and Bandy, 2003a; Lavkulich, 1969). The example used here is entirely arbitrary; ten thousand years might be accepted for a slow-forming mollisol, a typical alfisol, or a quick-forming ultisol.

Even if we grant the EGP assumption that a given soil takes, for example, ten thousand years to reach steady state ("maturity"), various anticipated rates at which this particular soil formed may differ greatly. Thus, although many EGP adherents have come to recognize the rapidity with which some individual soils or soil series may have formed in specific cases, the assumption of great ages continues (Crocker, 1960, p. 84; Guggenberger, Bäumler, and Zech, 1998; Klevberg and Bandy, 2003b). Interpretive differences arising from disparate natural history views are illustrated by Figure 5. As has been shown elsewhere (Klevberg and Bandy, 2003a; 2003b), pedogenic processes are not generally linear. This has been recognized by Birkeland (1974, p. 257), who proposed that soil formation generally is a sigmoidal function of time. We believe this is much more realistic than the linear assumption, but because Birkeland's EGP bias caused him to overestimate the time required for pedogenesis, this is still an unrealistic function. Note that if one selects an arbitrary percentage of steady state, say 50 percent, the inferred time of formation may differ by orders of magnitude. This shows how important historic presuppositions are to interpretation of the same data.

We believe that early pedogenesis probably occurs more rapidly than Birkeland recognizes and that an exponential or hyperbolic function is more realistic, as some diluvialists have suggested (Klevberg and Bandy, 2003b; Kohl, 2002) and as illustrated in Figure 5. The superiority of diluvial models can be demonstrated by many examples in addition to those given above. Rapid soil development has occurred in many irrigated regions of the American West where land was leveled to prepare it for surface irrigation. Deep cuts on the ridges exposed subsoil which was rapidly brought into production with good management (Kohl, 2002). Development of natriustalfs (alfisols with natric horizons) has been observed in South Dakota in less than sixty years (Westin, 1970, p. 17) and, in cases of high-sodium irrigation water, as little as two years (Kohl, 2003). The presence and chemistry of water, particularly ground water, has probably been much more important in pedogenesis than many researchers have formerly recognized (Jenny, 1941, p. 92; Klevberg and Bandy, 2003a). Plant succession can result in a highly nonlinear, decreasing-rate pedogenesis function (Bormann and Sidle, 1990; Crocker, 1960). Spodic and albic horizons have been observed to form in soils in Alaska in fewer than 150 years (Bormann et al., 1995).

Alternative Explanations for Paleosols

Assuming that some layers in rock, such as a clay or calcium carbonate rich layer, can be interpreted as a paleosol within the EGP, are there alternative explanations within the DGP? It is mainly the properties of these layers (one or more apparent soil horizons) and not root traces nor soil structures that can possibly be diagnostic. There are at least three other possible explanations, other than a paleosol, within the DGP for these layers:

- First, a clay, calcium carbonate, or a red layer could simply be a result of flood (or other fluid) deposition. A clay layer can be deposited rapidly by flocculation, while a red layer can be the result of iron-rich water. While clay particles will not settle readily, even in still water, aggregates of clay particles (flocs) will settle much more rapidly. Flocculation is commonly induced by the introduction of salts (e.g. $CaCO_3$, $CaSO_4$, $Fe_2(SO_4)_3$, and especially $Al_2(SO_4)_3$, alum)[2]. Introducing approximately 25 milligrams alum for each liter of severely turbid water (or 300 milligrams of gypsum per liter) typically clears the water of suspended clay particles in only a few hours (Hargreaves, 1999). Physical means (typically limited to careful piping layout and discharge geometry) are used successfully to provide rapid deposition of clay-size tailings at many mines. Thus, contrary to the arguments of some (Bowden, 2000; 2001; Froede, 2001; Klevberg, 2001), rapid deposition of clays–especially in the presence of iron and other salts–is not only possible but likely to have occurred during the year-long upheaval of the Deluge (Genesis 7:11), as well as on a smaller scale subsequently.

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[2] An exception is NaCl, since Na^+ is effective as a dispersing agent.

- Second, a sediment or rock can be modified anytime after deposition by ground water. When heat and moving fluids affect mineralogy, this is called hydrothermal alteration. During rapid deposition of sediments during the global Flood event—perhaps hundreds of meters in less than a day—the pressure of the accumulating sediment would tend to squeeze the water out. The water, under high pressure and charged with chemicals, could quickly alter the sediment through which it flowed. Even practitioners of the EGP recognize this. For instance, gray loams in the rocks of the Rhenish Massif have been interpreted as *both* the product of surficial weathering and the result of rock decomposition by hydrothermal ascending solutions (Meyer et al., 1983, p. 41). Deeply kaolinized granite in southwest England (the Cornubian batholith) is believed to be a reaction product of hydrothermal origin by some researchers (Thomas, 1994, p. 24). Many other batholiths exhibit weathering that is probably diagenetic rather than epigenetic (Snelling and Woodmorappe, 1998). Supposed "Precambrian paleosols" in South Africa may be better interpreted as indications of hydrothermal alteration along lithological contacts (Palmer, Phillips and McCarthy, 1989). This appears to be true of at least some similar deposits (Williams, 1969). Cliff Ollier and Colin Pain (1996, p. 62) admit:

  > Rising water, steam and other emanations from deep in the earth move upwards through enclosing country rock and bring about some alteration. This may include the formation of tourmaline or fluorite in hard rocks, but it may also include the formation of clays. This is not [surficial] weathering, but hydrothermally altered rocks may come to look very like weathered rocks....

- Third, a "paleosol" can be formed by diagenesis, which is the alteration of a sediment, exclusive of weathering and metamorphism, that includes compaction, cementation, oxidation, reduction, hydrolysis, bacterial action, and replacement. Froede (1998, p. 28) points out that diagenetic changes can be misidentified as paleosol horizons. During the Deluge, one would expect a large variety of diagenetic changes due to various combinations of heat, pressure, chemistry, etc., that those adhering to the EGP would exclude from their thinking. Diagenetic effects can easily mimic paleosols (Valentine and Dalrymple, 1976; Bowen, 1978, p. 182). Some investigators have found that early diagenetic ground water alteration can mimic hydromorphic soil features, such as pseudogley mottling and calcic horizons (Kraus, 1999, p. 61).

Identifying soil profiles and structures in the geologic record can be fraught with difficulties and requires caution. One should be suspicious of the "paleosol" interpretation when it is admitted that if the layer was once a soil, compaction and diagenesis have altered it (Retallack, 1990, p. 20). If altered or metamorphosed enough, the layer may become indistinguishable from a zone of hydrothermal alteration (Retallack, 1990, p. 129). Since alleged paleosols seldom exhibit a recognizable soil profile (Table I), creationists–or anyone–should be cautious about accepting the existence of paleosols in the rocks. Furthermore, the existence of roots or "root traces" should not automatically define a paleosol. This is crass uniformitarianism. One would expect all kinds of roots and root traces in sediments or sedimentary rocks caused by the Deluge, since the Flood-borne sediments would have buried many. One should especially be suspicious when the supposed soil-forming process was not enough to wipe out bedding planes or even ripple marks, as admitted by Retallack (1990, pp. 11, 31). Alternative explanations for alleged paleosols not only exist, they often appear much more likely (White, 1998).

The Equivocal Nature of Important "Paleosols"

The "paleosols" used to distinguish between various glaciations are difficult to identify, patchy, lack the A-horizon, and have been simply fit into the multiple glaciation assumption, among other problems (Valentine and Dalrymple, 1976; Oard, 1990, pp. 149–166). The American Midwest glacial/interglacial scheme is now considered wrong because there supposedly are many more glaciations over a longer period than earlier indicated by the "paleosols" (Boellstorff, 1978; Woida and Thompson, 1993). These many supposed glaciations are based on oxygen isotope ratios in deep-sea cores (Oard, 1984a; 1984b; 1985), yet another mixed question blending historical speculations with scientific data. This brings up the question of how the earlier geologists working in the Midwest could have correlated these geographically patchy soils over regional distances to deduce three interglacials between four ice ages.

Underclays are often relatively structureless and do not exhibit evidence of soil profile development. The overlying coal generally exhibits evidence of allochthonous, not autochthonous, depositional processes. These deposits are often stacked in a recognizable sequence (cyclothem) which, based on recent work by Berthault (1986; 2002a; 2002b) and others, is more likely an indication of rapid, energetic deposition than soil formation.

Vertical sequences of alleged paleosols, in contrast with cyclothems, do not generally form a recognizable sequence. Instead, the number of paleosols and their vertical extent are often matters of debate (Froede, 1998, pp. 26, 27). Such distinctions are essential if a pedostratigraphic column is to be formulated. That stratigraphic column then forms the basis for interpretations of age, paleogeography, and paleoclimatology. Whereas visitors to national parks and viewers of television programs are typically presented with such interpretive scenarios as if they were historic fact, the very basis for the inferences is often suspect, and all resulting interpretation becomes mere conjecture.

A Diluvial Approach to the Paleosol Question

In light of the information presented above, let us again consider the question, “Can paleosols exist?” Both the EGP and DGP allow for the existence of paleosols (Froede, 1998, pp. 21–28), if *paleosol* is defined as “a buried soil horizon in which soil forming processes are no longer operative.” However, the DGP does not admit the genesis of paleosols in the way envisioned by the EGP. Indeed, it is on this point of *history* that the mixed question produces conflict between the EGP and DGP. If soil formation requires the length of time widely credited to it by the EGP, then formation of a single soil horizon, let alone multiple paleosols, becomes impossible within the diluvial timescale. However, since pedogenesis can be significantly faster than professed by the EGP, and since catastrophes can (and do) bury soil horizons, paleosols can form, and certainly have. The DGP approach to natural history predicts that paleosols will be less common, less extensive laterally, and more rapidly formed than the EGP predicts (Froede, 1998, p. 28; Klevberg and Bandy, 2003b).

A danger in investigating a mixed question phenomenon such as paleosols arises at even the data collection stage. Evolutionists will be tempted to see a paleosol at every turn. Diluvialists may, for the same reason, tend to miss paleosols. Can one avoid this dilemma? Yes, if careful attention is paid to the separate lines of evidence demanded by the mixed question: careful collection of scientific data, logical analysis of the historical predictions, and careful testing of the historical predictions by means of the scientific data. This requires recognition of alternative explanations for alleged paleosols and uncertainties in rates of pedogenesis.

Implications for Paleopedology and Pedostratigraphy

In scientific research, error ranges or degrees of precision are very important and regularly reported. It is often critical to know the confidence interval of a result, and no measurement is complete without an implicit or explicit statement of precision. In historical research a similar situation exists. One of the most important tasks of the historian is to render a judgment on the reliability of a given witness to a given event versus the testimony of another, possibly conflicting witness. In neither case can we reach “absolute truth.” Both forms of research are human endeavors and subject to human limitations. Yet geologists and paleopedologists can display incredible dogmatism at times (unfortunately, this is not limited to evolutionists). It is vital that we remember that any paleopedologic interpretation is just that: an *interpretation*, and the answers we give to these mixed questions are always tentative, only as good as our historical and scientific data and inferences. We are limited by our ability to concoct historical scenarios and our ability to scientifically disprove them.

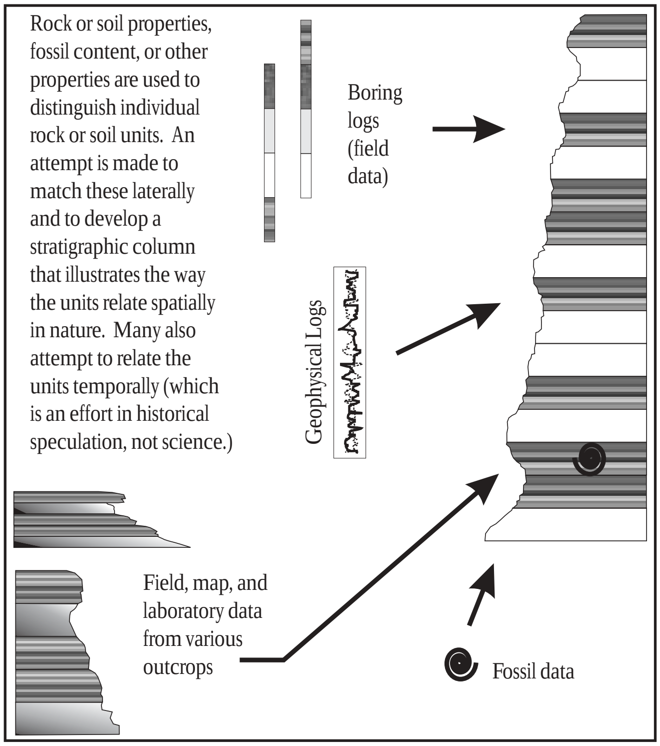

Rock or soil properties, fossil content, or other properties are used to distinguish individual rock or soil units. An attempt is made to match these laterally and to develop a stratigraphic column that illustrates the way the units relate spatially in nature. Many also attempt to relate the units temporally (which is an effort in historical speculation, not science.)
Boring logs (field data)
Geophysical Logs
Field, map, and laboratory data from various outcrops
Fossil data

Figure 6. How a stratigraphic column is assembled.

Pedostratigraphy naturally derives from paleopedology. Stratigraphy is the correlation of discrete bodies of earth materials to deduce their geometric orientation and relation to each other. Various methods can be used to develop local columns that represent this relationship vertically. The data may be of many kinds: lithologic, fossil, geophysical, etc., and from various sources: outcrops, borehole chips, geophysical surveys, etc. They may be gathered from widely scattered locations. These data are compared to see spatial trends in each kind of data, and these sequences compared in an effort to determine the local stratigraphic sequence. The local stratigraphic column that results can be displayed similarly to an outcrop or boring log, as shown on Figure 6. Where the earth materials investigated are soils, the correlation is called pedostratigraphy. Since none of us is satisfied to limit his inquiry to science, and knowledge of history is a basic human need, stratigraphy soon moves from descriptive correlation to historical speculation (Klevberg, 1999; Reed, 1996b;

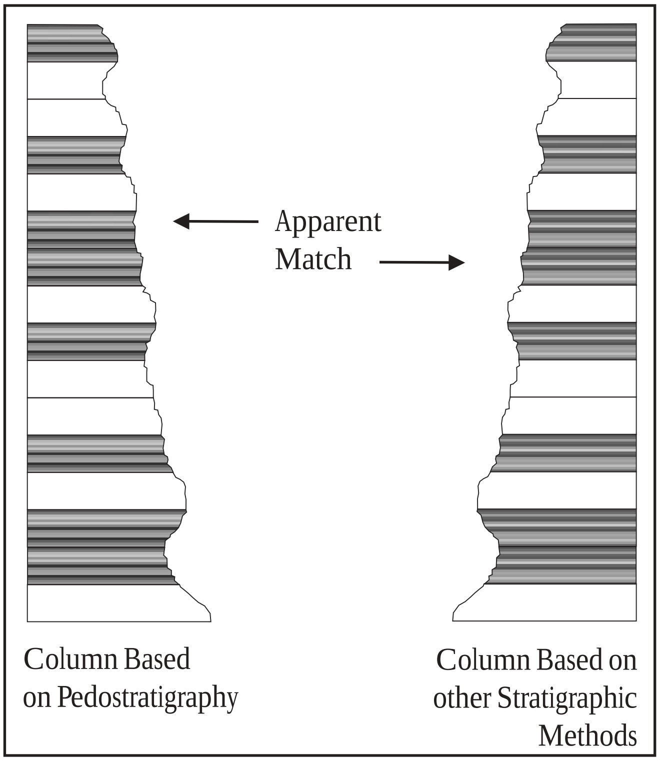

Apparent
Match
Column Based on Pedostratigraphy
Column Based on other Stratigraphic Methods

Figure 7. Apparent stratigraphic match which is not unique. In this illustration, pedostratigraphy appears to provide a perfect fit with other stratigraphic methods. However, because the correspondence is not unique, this may be coincidental or contrived.

2000). Some stratigraphic methods are actually historical rather than scientific or mix the two (Klevberg, 2000a).

For those not acquainted with stratigraphy, an example or two may be useful. One of us, while employed in the geology department of a major metals mine, was the field geologist for an extensive core drilling project to better delineate the geology of the mine area. A model had been developed already through several stages of drilling, and this model predicted locations of the diatreme hosting the ore, barren country rock, and dikes. The thickness, number, and location of these dikes proved different as a result of the new drilling data. The model was therefore refined. Theoretically a very accurate stratigraphic column could be developed by drilling every couple of meters in every direction, but the cost would be astronomical. Stratigraphy therefore fills the gap by synthesizing the available field data to form a predictive model. This then forms the basis for developing a new drilling program, and the cycle is repeated to the extent it is economically warranted (the mine model was an example of lithodemic stratigraphy, since these were not stratiform rocks, but it can be thought of as a local stratigraphic section or column). On another site, near the Canadian border in Montana, an electrical resistivity survey was conducted prior to drilling several shallow borings. The geophysicist conducting the survey interpreted the results as showing a plume of oil in the subsurface. Drilling showed very limited oil; what the resistivity survey had encountered was actually a sand-claystone contact. The geophysical data were the differences in resistivity. Without lithologic control from the borings, they could not be related to the site geology. However, the sequence of the strata developed using these two independent methods matched. The stratigraphy for the area between the drill holes could then be inferred with considerable confidence from the resistivity data that had previously been misinterpreted as showing a plume of oil.

One often hears arguments about "independent lines of evidence" establishing a certain age-dating or stratigraphic scheme. Such lines of "evidence" are immediately suspect when mixed questions are involved. Often, they are simply examples of the reinforcement syndrome (Klevberg, 2000b, p. 95; Oard, 1997, p. 11; Thompson and Berglund, 1976), a psychological phenomenon wherein researchers increasingly attempt–and possibly succeed–in finding data to support a popular new hypothesis in a kind of bandwagon effect until the hypothesis is simply assumed by the scientific mainstream. As described elsewhere, pedostratigraphy (stratigraphic correlation based on paleopedology) is not a strictly *scientific* approach to stratigraphy, whatever other merits it may have (Klevberg, 2000a). So what of the "agreement" between various methods? There are several possibilities:

- Assuming that the paleopedologic interpretation is right, and it is in agreement with magnetostratigraphy, assumed evolutionary succession ("biostratigraphy"), etc., then it would tend to support the EGP interpretation. However, this support is very weak if the correspondence is not *unique*, as has been demonstrated elsewhere relative to cyclothems (Zeller, 1964) and eustatic curves (Miall, 1992). Although the apparent correspondence between the stratigraphic sequence determined by one method and another method may be impressive, one must be careful to determine that this is not a cyclic pattern or the result of researcher bias. Correspondence may be fortuitous or contrived. This is illustrated by Figure 7. Cyclothems, repetitious sequences, properties that do not follow lithologic boundaries, and correlations with limited exposure and significant lateral facies changes can be especially problematic. If, for example, data from many sources all show alternating, meter-thick beds of sandstone and claystone that are virtually indistinguishable from similar beds above and below, nearly any shift of two meters up or down will make any two boring logs match. No one would find this convincing. But, a pattern such as that in Figure 7 could easily fool a geologist into thinking the stratigraphic relations of the rocks had been determined, while the columns derived from different methods or sets of data are really shifted relative to each

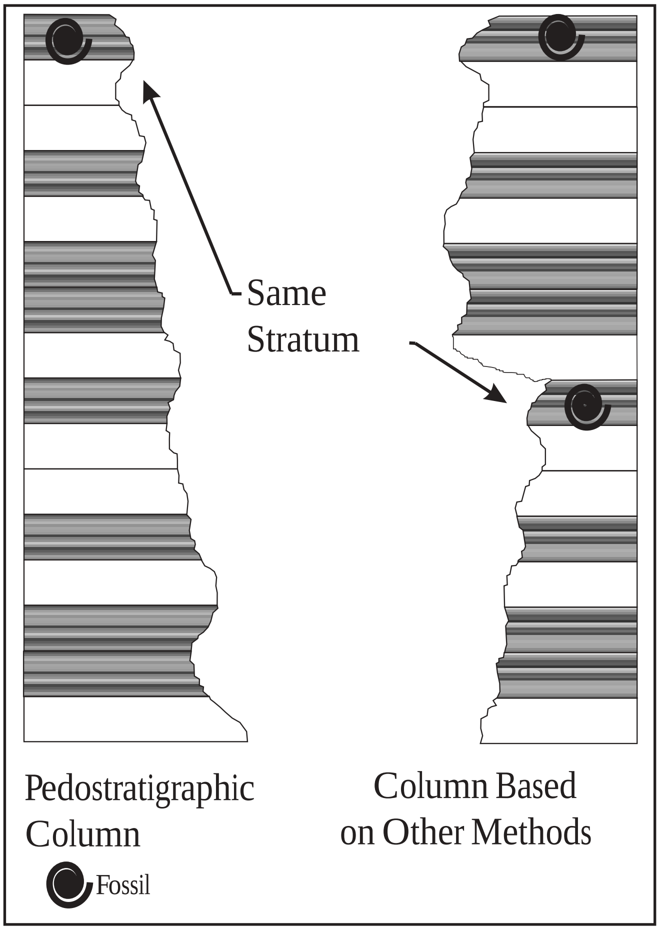
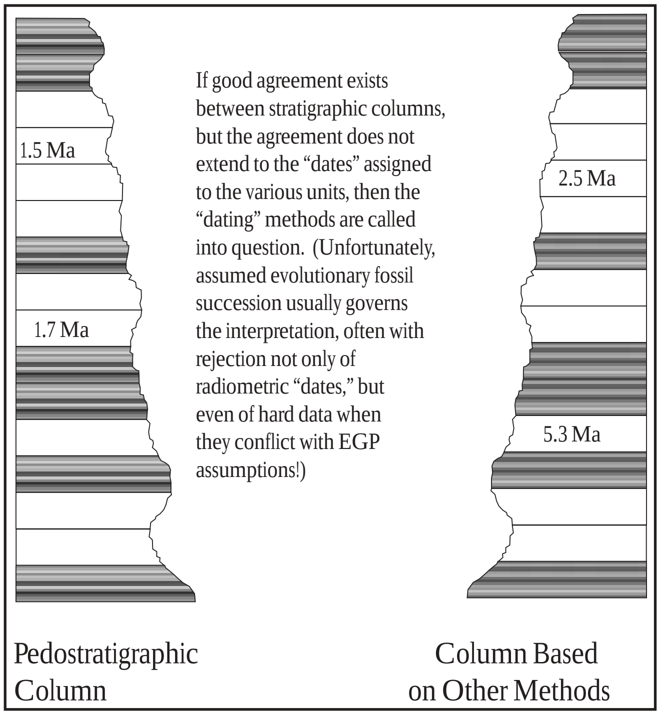


Figure 8. Mistaken stratigraphic correlation of cyclic strata. Illustration of nonunique stratigraphic sequences with false apparent correspondence between stratigraphic methods.

other. Pedostratigraphy may produce a sequence that appears identical to one determined using geophysical methods (e.g. resistivity or remanent magnetization), yet this sequence may be repetitious and correlations between methods fallacious, as illustrated by Figure 8.

- Assuming that the paleopedologic sequence is right, and it is in agreement with other stratigraphic methods, but the time required to form the sequence differs from the accepted EGP interpretation using other stratigraphic and "dating" methods, then the likelihood that the timescales of the other methods also need revision appears high. This is illustrated by Figure 9. Unfortunately, radiometric "dating" (methods which are historical and unscientific) are often used to *force* the data from other methods to "agree:" introducing hiatuses, overthrusts, paraconformities, etc., instead of assembling the individual types of data independently. Many EGP stratigraphers force everything, including radiometric "dates," to fit into the supposed fossil succession. Any fossil succession that may exist and any veracity radiometric dates may have are impossible to evaluate when other stratigraphic methods (including strictly scientific ones) are ignored or abused in this way.



If good agreement exists between stratigraphic columns, but the agreement does not extend to the "dates" assigned to the various units, then the "dating" methods are called into question. (Unfortunately, assumed evolutionary fossil succession usually governs the interpretation, often with rejection not only of radiometric "dates," but even of hard data when they conflict with EGP assumptions!)

Figure 9. Matching stratigraphic columns with discordant "dates."

- If the sequence of strata is quite complicated or nearly random, agreement between a local stratigraphic column developed using paleopedology and a sequence developed using another stratigraphic method would tend to enhance confidence in the interpretation. (Stratigraphic correlation of nonstratiform materials can be quite difficult, and we will limit our illustrations here to stratiform earth materials.) This is illustrated by Figure 10. If the paleopedologic interpretation is wrong, and a sequence of strata represents a number of geologic events different from the paleopedologic scenario, then the alleged correspondence between pedostratigraphy and biostratigraphy or magnetostratigraphy is also wrong. This casts doubt on these other methods, especially if the correspondence between methods appears strong at the time one is discredited. This is illustrated by Figure 11.
- If the paleopedologic interpretation is doubtful, and the correspondence with other methods is clearly not a unique solution, then no mutual support between methods can be adduced, however convincing they may appear superficially. This is illustrated by Figure 12.
- If the paleopedologic interpretation conflicts with correlations based on other methods, at least one of the methods is invalid. This applies to any two stratigraphic (along with "absolute dating") methods. This is illustrated by Figure 13.

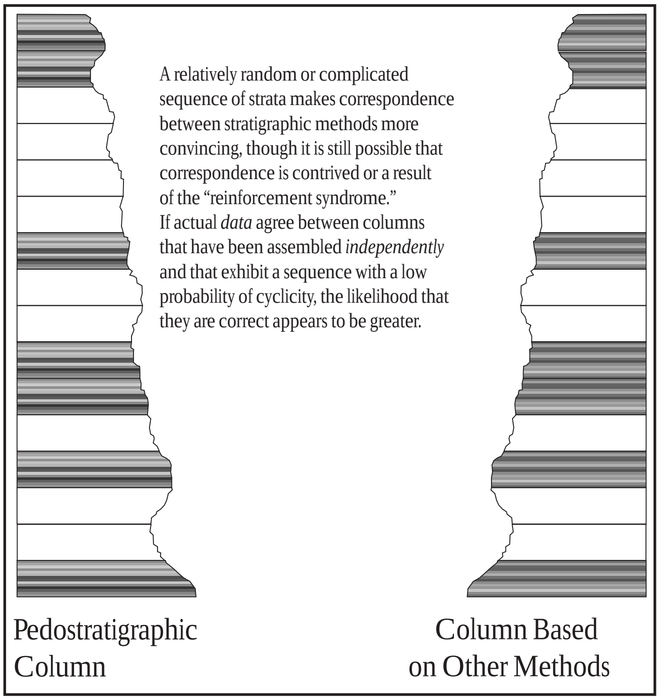

A relatively random or complicated
sequence of strata makes correspondence
between stratigraphic methods more
convincing, though it is still possible that
correspondence is contrived or a result
of the "reinforcement syndrome."
If actual *data* agree between columns
that have been assembled *independently*
and that exhibit a sequence with a low
probability of cyclicity, the likelihood that
they are correct appears to be greater.
Pedostratigraphic Column
Column Based on Other Methods

Figure 10. Convincing correspondence between stratigraphic methods.

- To provide a truly meaningful comparison, the pedostratigraphic column must be developed *independently* of the other methods and then compared with the results obtained using these other methods. Unless this is carefully observed, bias can be expected and the results dismissed as another example of the reinforcement syndrome. In general, uniformitarians specifically *avoid* using pedostratigraphy independently of the other stratigraphic methods, though some warn of the need for quantitative data and care in avoiding this pitfall (Birkeland, 1984, p. 339).

When DGP assumptions are substituted for EGP assumptions, conclusions can differ markedly. For example, suppose an EGP researcher believes ninety paleosols are represented in the wall of a canyon. Although unable to disprove the paleosol interpretation, field evidence may suggest that two-thirds of the "paleosols" are better explained by energetic geologic processes. If the average time required for a soil in the paleopedologic sequence to form was 150 years (and negligible time for the geologic events), the resulting total time for formation of the sequence would have been 4,500 years. This is several orders of magnitude less than the EGP scenario, yet the DGP results are in good agreement with historically observed rates of pedogenesis. Obviously, this is a gross simplification and only intended to be illustrative; each site warrants a careful, detailed investigation.

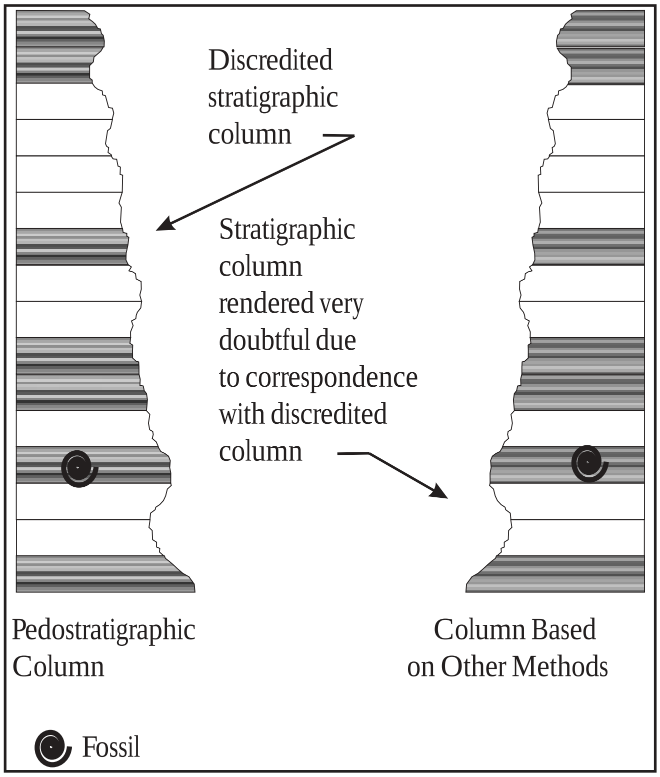

Discredited stratigraphic column
Stratigraphic column rendered very doubtful due to correspondence with discredited column
Pedostratigraphic Column
Column Based on Other Methods
Fossil

Figure 11. Discredited column with good correspondence to other methods.

Conclusions

The field of paleopedology is a mixed question domain. All of its results are speculative, and interpretations are highly dependent on researcher bias. Alternative explanations for apparent pedogenic features are abundant and often superior. Paleosols are not inimical to the DGP, but the expectations and interpretations of antithetical paradigms certainly lead in very different directions. This is especially true in the expected abundance and rate of formation of paleosols. Care must be exercised by researchers in this field to separate scientific data from historical data and to separate data from interpretation. Data acquisition must be as complete as practical and distinct from inference. Even then, the resulting interpretation is essentially tentative and must be identified as speculation. Speculative paleosols lead to speculative successions of paleosols, speculative pedostratigraphic columns, and speculative paleogeographic and paleoclimatologic reconstructions. Since these pedostratigraphic columns must be viewed with great skepticism, apparent agreement between "independent" stratigraphic methods must be approached with even greater skepticism, and one must beware of the possible influence of the reinforcement syndrome. Due to ubiquitous EGP bias, it may well be that many paleosols exist only in the mind of the beholder.

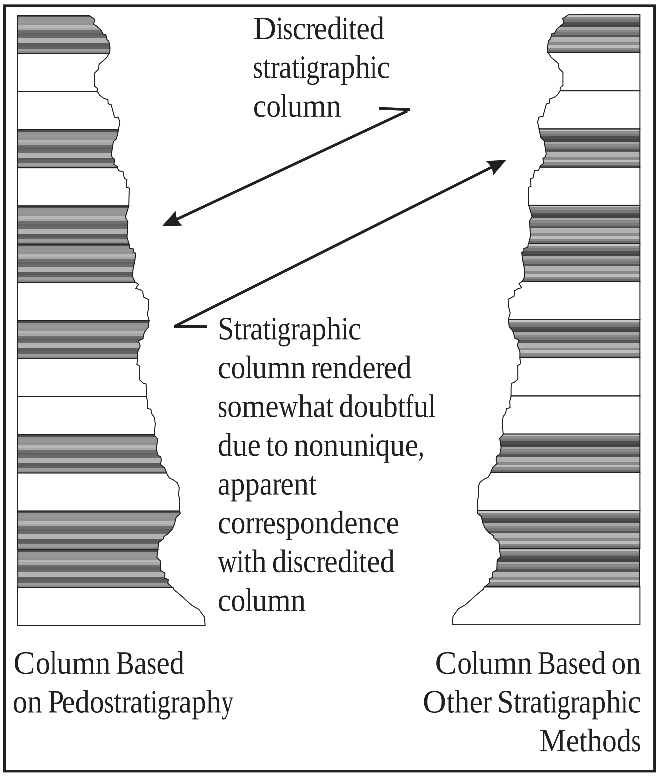

Discredited stratigraphic column
Stratigraphic column rendered somewhat doubtful due to nonunique, apparent correspondence with discredited column
Column Based on Pedostratigraphy
Column Based on Other Stratigraphic Methods

Figure 12. Doubtful correspondence with doubtful column.

Glossary

albic horizon: said of an eluvial soil horizon containing at least 85 percent material exhibiting a color determined largely by the primary sand and silt particles rather than particle coatings, implying that clay and free iron oxides have been removed from the materials or that the oxides have been segregated to such an extent that the colors largely reflect the natural mineral color of the sand and silt particles. Albic horizons usually occur beneath A horizons.

allochthonous: formed by transport to the location where it is now found rather than by growth in place.

autochthonous: formed *in situ* in approximately its present position rather than by transport from elsewhere.

DGP: the "diluvial geologic paradigm," a stereotype of the view that earth history has been dominated by catastrophic processes (principally the Deluge), a relatively short history as indicated by the Bible, and creation. Energy is the most important geologic variable.

diluvial: resulting from or pertaining to the Deluge, the global Flood cataclysm described in Genesis.

EGP: the "establishment geologic paradigm," a stereotype of the prevailing view that earth history has been dominated by gradual processes, immense amounts of time, and evolution. Time is the most important geologic variable.

glaebule: a particle within the soil matrix that is distinct from it due to composition, fabric, or some recognizable boundary that encloses it. It does not appear to have resulted from the soil-forming processes that produced the soil in which it is found.

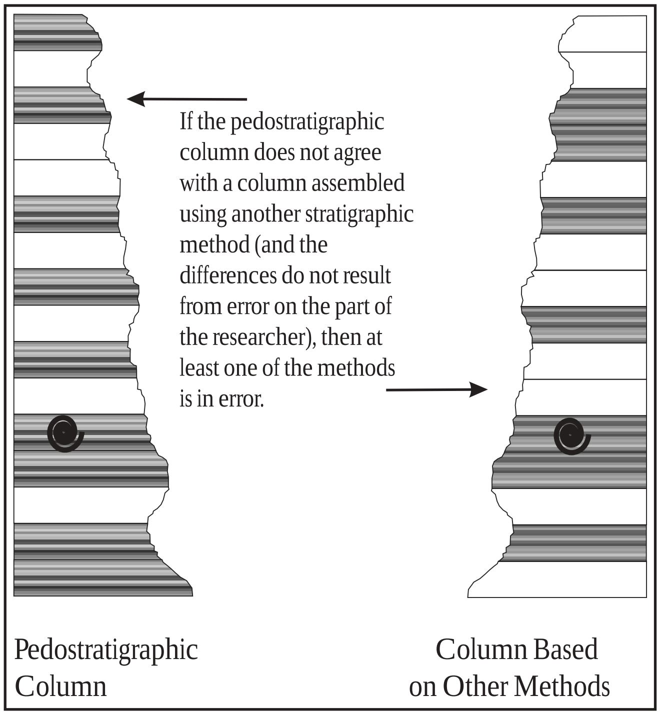

If the pedostratigraphic column does not agree with a column assembled using another stratigraphic method (and the differences do not result from error on the part of the researcher), then at least one of the methods is in error.
Pedostratigraphic Column
Column Based on Other Methods

Figure 13. Lack of correlation between stratigraphic methods.

maturity: a term often used in the past to indicate the extent of soil development; however, this term is associated with discredited concepts and is not presently favored. The term "steady state" is preferred and refers to dynamic equilibrium of soil-forming processes with environmental factors (Klevberg and Bandy, 2003a; Lavkulich, 1969).

natural history: as used in this paper, *natural history* refers to the history of nature or earth history.

neocuvierist: a term loosely applied to neocatastrophists who envision large scale catastrophes and hold to periodicity (secular) or accord great importance to presumed postdiluvian catastrophes (creationist).

paleopedology: the study of paleosols.

solum: refers to the upper horizons of the soil where pedogenic processes occur; it overlies the C and R horizons (parent material).

spodic: said of a soil horizon characterized by accumulation of iron and aluminum sesquioxides, organic complexes and organic matter, and frequently found beneath an E horizon in forested terrain.

xeric: a moisture regime found in areas with a Mediterranean climate and characterized by moist, cool winters and warm, dry summers. The moisture, which falls during the winter when potential evapotranspiration is at a minimum, is particularly effective for leaching. In normal years the soil moisture control section is dry in all parts for 45 or more consecutive days in the four months following the summer solstice and moist in all parts for 45 or more consecutive days in the four months following the winter solstice.

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CRSQ: Creation Research Society Quarterly

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Book Review

Resurrecting Genesis by John R. Hadd
Dorrance Publishing Co., Pittsburgh, PA. 2002, 240 pages, $24

Author Hadd completed a career of Federal government police service. He has studied the creation-evolution debate for over three decades. This book is well written and attempts to "challenge … orthodox Darwinism without surrendering to fundamentalist creationism" (cover).

Four distinct approaches to origins and history are defined: materialistic evolution, theistic evolution, progressive creation, and young-earth creation (p. 103). Hadd lists three "problems" with the young-earth view as favored by the CRS (p. 103). First is the literal interpretation of Genesis 1. Second is the young age view itself, thousands of years instead of billions. Third is reliance on the Genesis Flood for reshaping the entire earth's surface. The book is somewhat confusing since Hadd thoroughly and correctly debunks radioisotope dating, a mainstay of old-earth thinking. He also describes in detail the tremendous tectonics which accompanied the Flood. An ark made of reeds is promoted as described by David Fasold (p. 79). It is unclear whether Hadd prefers a local or global flood.

The author holds to the progressive creation view. He believes that God orchestrated many animal/plant creations and extinctions over eons of time before mankind's appearance. The reason, Hadd says, was to provide mankind with object lessons (fossils) on the stewardship of life on earth (p. 66). This view is rather strange, that animal extinctions somehow teach the importance of life. In response, Hadd writes "No human being…has any place attempting to dictate strategy to the Creator" (p. 98). Hadd has simply been forced into this position of multiple animal extinctions by the progressive creation stance.

Much detail is given to cataclysmic events in earth earth history. These include interactions with other planets and the theories of catastrophists Isaac Vail, Immanuel Velikouvsky, and Donald Patten.

Several valuable appendices are provided. Ten pages are given to the Williamsburg Charter, a 1998 document which promotes religious liberty. Fifty pages are given to *Commentary* reprints of David Berlinski articles which challenge evolution and the big bang. Also included are 32 follow-up letters which appeared in Commentary, both for and against Berlinski

The reader may not agree with author Hadd's viewpoints but the information is nicely laid out and is challenging.

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Book Review

The Dating Game by Cherry Lewis

Cambridge University Press, Cambridge. 2000, 258 pages, $20

This is the life story of English physicist and geologist Arthur Holmes (1890–1965). The author is herself a geologist and a delightful writer. Holmes pioneered the radioisotope dating of rocks, later joking that "the Earth has grown older much more rapidly than I have—from six thousand years when I was ten, to four or five billion years by the time I reached sixty" (p. 234).

Holmes was a world class geologist. At age twenty he prospected for a company in Mozambique and contracted malaria. Later he worked in the oil fields of Burma, where his three-year-old son died of dysentery. In later years Holmes was a geology professor at England's Durham (1924) and Edinburgh (1943) Universities.

Holmes was determined to stretch out the accepted age of the earth. As so often happens, he was greatly influenced by a teacher. At the high school level, "It was Mr. McIntosh who taught them to laugh at the [6000 year] teaching of Gosse" (p. 24). Holmes received little Biblical counsel from home: "all he learnt from his parents was that to question the 'Word of God' was simply 'not done'" (p. 27). Holmes held an unsatisfying, atheistic view of life (p. 143). At age twenty he wrote, "I felt somehow what a fearful meaningless tragedy the Universe appeared to be…[I reject] the comtemptibly conceited idea, that the whole purpose of existence is man" (p. 93-94). The book also points out a little-known dark side of Holmes' life: When his first wife Maggie died, Holmes soon married his long-time mistress Doris Reynolds, another geologist.

Holmes' entire career had the goal of establishing a time scale for the geologic column. He distained the short time scale for earth (still millions of years) as promoted by Kelvin and John Joly. Holmes called their dating techniques, mainly earth cooling, sea salinity, and sedimentation rates, "hour-glass" methods. He rejected the results because they did not give a long enough earth age.. Holmes was enamored by the new radioisotope method of dating rocks (1900) and was one of the few geologists to understand and use the technique. One cannot discount the patient, precise chemical separations of radioactive parent and daughter atoms which Holmes carried out. Through his work the vast geologic time scale was established. His classic book *Principles of Physical Geology* (1944) is still useful today. Holmes succeeded in converting modern geology completely over to "deep time." Creationists today are taking a close look at the many assumptions and variables of radioisotope dating. With possible sample contamination and accelerated rates of decay in the past, the final chapter on the age of the eath has not yet been written.

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> "Instead of the straightforward biblical account of God's creation, the theistic evolution view has to understand events to have occurred something like this: And God said, 'let the earth bring forth living creatures according to their kinds.' And after three hundred eighty-seven million four hundred ninety-two thousand eight hundred seventy-one attempts, God finally made a mouse that worked. That may seem a strange explanation, but it is precisely what the theistic evolutionist must postulate for each of the hundreds of thousands of different kinds of plants and animals on the earth; they all developed through a process of random mutation over millions of years, gradually increasing in complexity as occasional mutations turned out to be advantageous for the creature."

—Wayne Grudem, *Systematic Theology* (Grand Rapids, MI.: Zondervan, 1994), pp. 276–277.
(Dr. Grudem is Professor of biblical and systematic theology at Trinity Evangelical
Divinity School, Deerfield, Illinois. He holds a Ph.D. from Cambridge University.)

The Geology of the Kansas Basement: Part I

John K. Reed*

Abstract

The identification of deficiencies and errors in the presuppositions and methods of uniformitarian natural history should be accompanied by an empirical reinterpretation of geological data within the Biblical Worldview. The wealth of geological and geophysical data demands a systematic replacement of the ruling paradigm by creationist explanations of the rock record. Such a reinterpretation is underway for the geology of Kansas, and the first step in that project addresses the basement. The erosional contact between the crystalline basement and overlying sediments can be interpreted as the erosional basal Flood boundary. The exception to this interpretation is found at the Midcontinent Rift System, a complex of basalt flows and adjoining sedimentary basins. This feature is interpreted as the tectonic basal Flood boundary, marking tectonic disruption associated with the Flood onset, with both basalt flows and sedimentation occurring between the onset of the Flood and its marine inundation of the region.

Introduction

Natural history is an important battleground between the worldviews of Christianity and naturalism. The latter has internal fatal defects (Reed, 2001), although its adherents continue to place great confidence in it as a bulwark against Christianity. Having dominated the arena since the time of Charles Lyell, the father of modern uniformitarian geology, it has a large corpus of literature, but since the framework and method are logically flawed, it follows that interpretation is, too. Christians have a coherent method for natural history, but few detailed models and a relatively modest corpus.

Conflict over natural history cannot be resolved at the empirical level, but can be by the demonstration of contradictions between presuppositions, conclusions, and methods within Naturalism. This level of analysis is becoming more prevalent with regard to evolution, but connections between Naturalism and uniformitarian natural history appear to escape many capable critics (e.g., Johnson, 1997; Pearcy and Thaxton, 1994; Behe, 1996; etc.).

Although a formal case against uniformitarian natural history can be argued successfully, those arguments do not resonate in our empirically oriented culture. Thus, the argument should be supplemented by a reinterpretation of natural history within the Biblical Worldview to attract the attention of our contemporaries and still the voices of skeptics. Interpretation must be constrained by the primacy of Scripture, a strong distinction between history and science, and the mixed question approach (Reed, 2001).

A major barrier to comprehensive reinterpretation is scale. On one end, global Flood models have been proposed, and on the other, specific locales interpreted. However welcome these efforts, it remains true that with few exceptions (e.g., Austin, 1994; Reed, 2000), most creationist efforts have not attempted the systematic displacement of uniformitarian interpretation point by point over a regional extent and/or the entire range of the geologic record.

The geology of North America is perhaps as well known as that of any other place on Earth, and the geologic profession in North America led the discipline in the twentieth century. A complete reinterpretation of North American geology within a biblical framework is a strategic goal that must be pursued by North American creationists; just as similar strategies are undertaken worldwide by our international colleagues (e.g., Lalomov, 2001; in press).

This paper addresses the midcontinent region of North America and the centrally located state of Kansas. Advantages include geographic centrality, an extensive historic database, and a relatively uncomplicated stratigraphic record. A goal of this and future efforts is to examine the regional geology from basement to surface and to reinterpret its geological features into a historical model constrained by the biblical record. A regional study of the Midcontinent Rift System (MRS) has been completed (Reed, 2000), and this paper will interrelate this feature in Kansas with the remainder of the predominantly crystalline basement.

Methods and Data

Except for xenoliths found in kimberlite pipes in Riley

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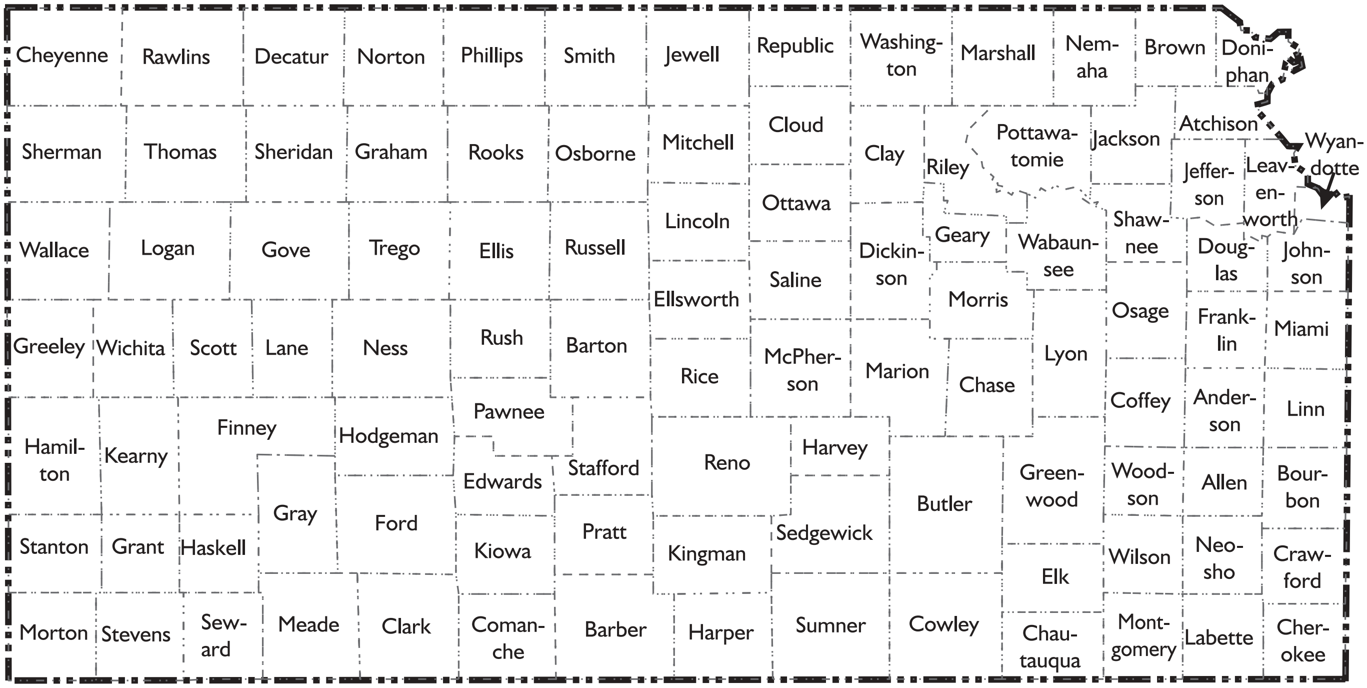

Figure 1. Kansas counties.

and Marshall Counties (Figure 1) and granite xenoliths occurring in peridotites in Woodson County, no basement rocks are exposed in Kansas (Brookins, 1970; Berendsen et al., 2000; Bickford et al., 1971). The oldest exposed strata are Mississippian [mention of the systems, etc. of the uniformitarian geologic column is presented for comparative reference only; the author rejects their absolute and sometimes, their relative dating efficacy], found in far southeastern Kansas (Ross, 1991). Thus, only subsurface methods are available to researchers to delineate basement features (Figure 2). These include geophysical (gravity, aeromagnetic, and seismic) surveys; and cores, cuttings, and logs from wells.

Regional studies of unexposed Precambrian basement have focused on geochemical (especially isotopic) data from cores to define specific domains of chemical and isotopic similarity. However, geophysical data often do not recognize the boundaries derived from geochemical studies and vice versa (Van Schmus and Bickford, 2001). Geophysical data are more regularly distributed (especially statewide gravity and magnetic surveys), but provide only indirect measurement of selected basement properties; seismic velocity, acoustic impedance, density variations [base on gravity field variation], and magnetic polarization contrasts (Hinze and Braile, 1988). A good summary of data sources, their strengths and weaknesses, and their relevance to the midcontinent basement is found in Hinze (1996).

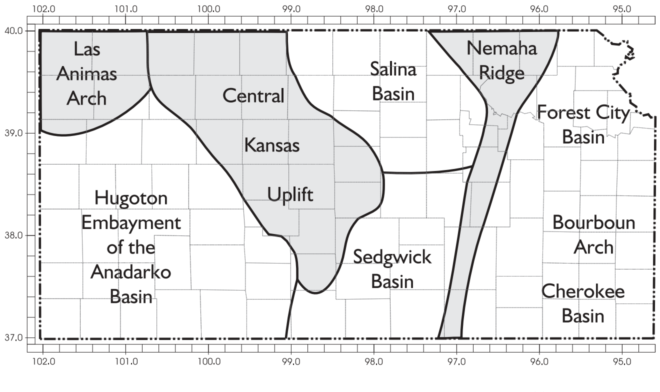

Figure 2. Basement features of Kansas after Zeller (1968).

Gravity

The Kansas Geological Survey (KGS) collected gravity measurements between 1976 and 1992. Over 62,000 station measurements were recorded at one-mile intervals on an east-west axis, and between two and six mile intervals on a north-south axis. These stations were tied into a series of KGS base stations, which were in turn tied to Department of Defense stations and the International Gravity Standardization Net of 1971. Data were corrected for earth tide effects and instrument error, and the Bouguer anomaly at each station was calculated by adding the free air correction, and subtracting the reference field and Bouguer correction (Lam, 1986). A map was produced from the calculated Bouguer gravity anomaly (Xia, 1992; Xia et al., 1993) with a specified accuracy of 0.1 to 0.2 mgals, depending on the accuracy of the field location (X-

Y-Z) measurements for each station.

Interpretation of gravity data was enhanced by separation of local and regional gravity anomalies using trend surface analysis (Lam, 1986). Detection and interpretation of gravity anomaly trends were correlated to magnetic data. He used artificial illumination of the gravity map to reveal subtle trends and obtained an isostatic anomaly by subtracting the isostatic correction from the Bouguer anomaly.

Limitations of the gravity method restrict its application in geologic interpretation. Spacing of the measurements limits the detectable size of the body generating an anomaly. Anomalies can be generated by density variations in the crust, however density ranges of crustal materials overlap and can be further affected by porosity, temperature, water and gas saturation, and mineralogy. Anomalies depend on the size, shape, depth, and density contrast with surrounding crust. Large, shallow or smaller, deep bodies result in long wavelength spectra. Shallow, small bodies generate short wavelengths. The variety of solutions to the potential field problem require additional data be used to constrain gravity anomaly interpretations (Lam, 1986).

Magnetic Data

More than 72,000 line kilometers of high quality aeromagnetic data were acquired by the KGS in the late 1970's and early 1980's (Yarger, 1983). Measurements were tied to specific locations and the resulting map was transformed to the spectral domain, filtered to enhance interpretation, and then transferred back to the spatial domain. Details of filtering are provided in Table 1 of Yarger (1983). The root mean square error for the magnetic data was calculated at 3 nanoteslas (nT).

Xia (1992) and Xia et al. (1995) performed inversion of a combination of gravity and magnetic data to study the thickness and nature of the crust. Since both gravity and magnetic anomalies are partly caused by the shape of the basement topographic surface and its lithology, and since the topography can be modeled (Cole, 1976), the anomalies relative to lithology can be derived. Although density and magnetization are not unique to lithology, they can provide significant information about rock types. Using this information with well and seismic control, Xia (1992) and Xia et al. (1995; 1996) derived a basement lithology map based upon the inversion of the potential-field data.

Seismic Data

Although significant numbers of seismic lines exist in Kansas, most are proprietary to oil and gas companies, or are too expensive to acquire. Sophisticated manipulation of such data requires workstation capability. However, published reports of several seismic datasets are available in the general literature. Between 1979 and 1981, the Consortium for Continental Reflection Profiling (COCORP) acquired three lines totaling 317 km of reflection seismic data in northeastern Kansas, across the MRS, the Nemaha Tectonic Zone, and the Humboldt Fault (Figure 3). The lines were interpreted initially by Serpa et al. (1984), and were later reprocessed and reinterpreted by Woelk and Hinze (1991), and even later reinterpreted by Berendsen (1997).

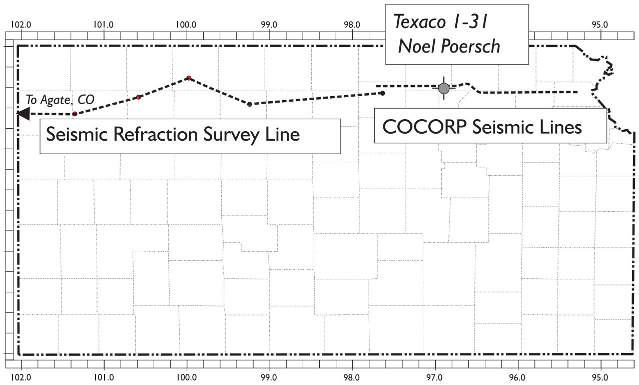

Figure 3. Location of Texaco #1 Noel Poersch well, COCORP seismic reflectionline, and Kansas Geological Survey seismic refraction line. After Berendsen et al. (1988) and Steeples and Miller (1989).

A seismic refraction line (Figure 3) was acquired from Concordia, Kansas to Agate, Colorado (Steeples and Miller, 1989). Seismic refraction data are useful for determining gross crustal properties, such as thickness. These data showed an average crustal velocity of 6.1 km/sec and an average upper mantle phase velocity of 8.29 km/sec. Depth to the Mohorovicic Discontinuity (MOHO) was 36 km at Concordia, steepening to 46 km in Agate. The depth to Moho was modeled by gravity inversion by Xia and Spowl (1995) and derived similar results. They derived comparative depths of 35.2 km and 43.5 km, respectively.

Well Data

Oil and gas have historically been produced from numerous fields in Kansas (Jewett, 1954). Significant production is associated with the Hugoton embayment of the Anadarko Basin, the Forest City Basin, and fields associated with the Central Kansas Uplift and Nemaha Anticline structures. As of 1983, almost 3500 wells had been drilled to basement (Cole and Watney, 1985). Between 1984 and the present, roughly 1000 additional wells have

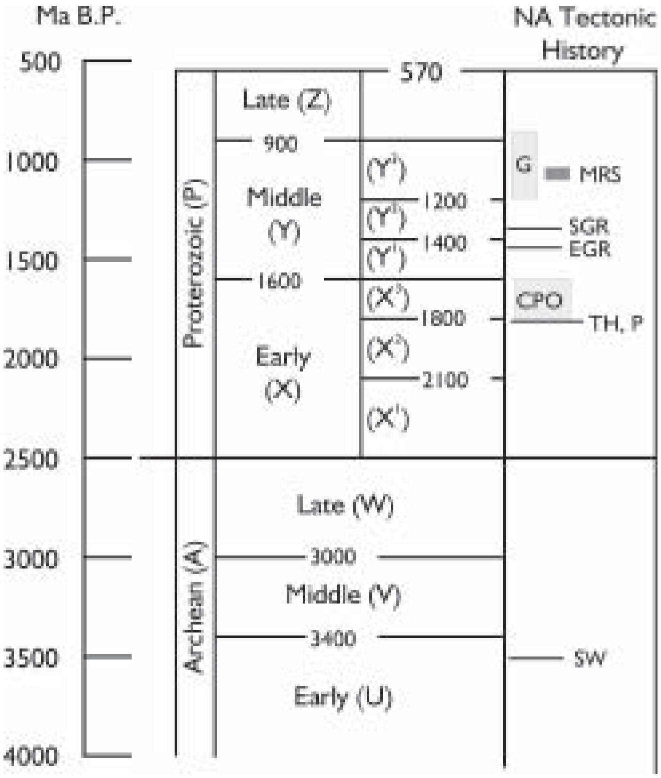

Figure 4. Precambrian time scale with elements of North America's uniformitarian tectonic history. SW is the Superior/Wyoming province, TH is the Trans-Hudson orogen, P is the Penokean orogen, CPO is the Central Plains Orogen, EGR is the Eastern Granite-Rhyolite province, SGR is the Southern Granite-Rhyolite province, G is the Grenville orogeny and MRS is the Midcontinent Rift System. The timescale is from Reed (1993).

been drilled to basement in Kansas (Watney, personal communication). Although the data from these wells varies (drill cuttings, cores, logs, etc), all of them are sufficient to give a depth to basement, and the gross lithology of the rocks encountered. Of those wells documented by Cole and Watney, only 253 penetrated 100 feet or more into the Precambrian basement. A more detailed description of pre-Paleozoic rocks was obtained from the drilling of the Texaco 1-31 Noel Poersch well in 1985 (Berendsen et al., 1988) to test oil and gas potential in MRS clastic sediments.

Geology of the Midcontinent Basement

Some knowledge of the surrounding regional Precambrian basement is required to place the features of the Kansas basement in context. Precambrian basement is exposed only over roughly 10% of the conterminous United States, of which only 25% has been mapped in detail (Reed, 1993). Interpretations of the basement are performed with reference to two fundamental assumptions: (1) the existence of joined crustal terranes of distinct origin and history, defined on the basis of radiometric ages (with consideration of lithology, geochemistry, rare-earth geochemistry, and structure), and (2) the application of the plate tectonics paradigm, despite sparse evidence relative to Phanerozoic examples. Therefore, emphasis is placed on grouping terranes by isotopic age and a presumed plate tectonics history. Timing of Precambrian events is considered less understood than Phanerozoic events tied to dates via fossils and stratigraphic position. A generally accepted time scale (Figure 4) was not derived until the early 1980's (North American Committee on Stratigraphic Nomenclature, 1983).

The midcontinent basement is a part of the North American craton. Sloss (1988) defined a craton as a stable continental interior, but noted that the transition from a geosynclinal approach to a plate tectonics approach rendered the definition of cratonic margins uncertain and time dependent. A marked feature of a craton is its stability for "…tens of millions of years of the solid surfaces of cratonic lithosphere within tens of meters (or at most, one or two hundred meters) of sea level…" (Sloss, 1988, p. 2). Cratonic stability is less emphasized within the paradigm of plate tectonics, and development of cratonic basins is tied to stresses transmitted from tectonic events (Leighton, 1996), although it is not suggested that dramatic vertical and lateral motions occur in continental interiors. Hinze and Braile (1988) defined the North American craton as that portion of the continent between the Appalachian-Ouachita orogenic belt and the Rocky Mountains, noting its relative stability for roughly one billion years. According to uniformitarian accounts, accumulation of a lasting, widespread sedimentary cover did not occur until the Phanerozoic, some 500,000,000 years later.

General physical features of the crust include crustal thickness, and mean compressional wave velocity for both the crust and upper mantle. Mean values for these features in the midcontinent region have been calculated as 42 km, 6.5 km/s and 8.1 km/sec, respectively (Hinze and Braile, 1988; Hinze, 1996). Hinze (1996) also notes that average heat flow for the northern midcontinent is approximately 1.4 HFU, average Bouguer anomaly is approximately –39.5 mGal, and average elevation is near 278 m.

Topographically, the regional basement surface in the midcontinent (Sims, 1990) dips to the south from surface exposures in Minnesota and Wisconsin (exposed basement extends north and east into the Canadian Shield) to deeply buried rocks in the south in the Anadarko-Arkoma-

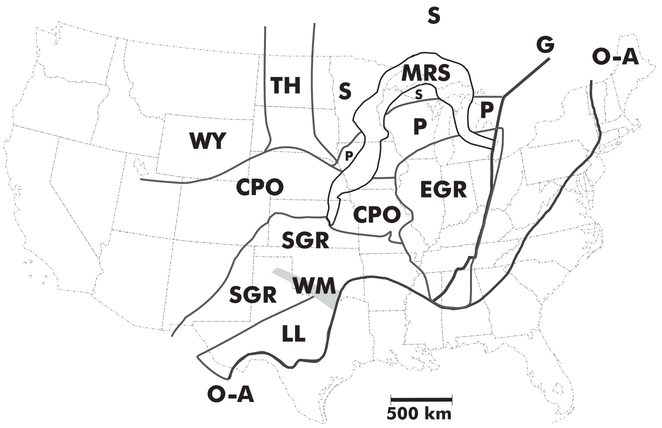

Figure 5. Basement provinces of the North American Midcontinent. S is the Superior province, W is the Wyoming province, TH is the Trans-Hudson orogen, CPO is the Central Plains Orogen, P is the Penokean orogen, EGR is the Eastern Granite-Rhyolite province, SGR is the Southern Granite-Rhyolite province, G is the Grenville front, MRS is the Midcontinent Rift System, LL is the Llano province, WM is the Witchita Magmatic province, and OA is the Ouachita-Appalachian front. Modified from Van Schmus et al. (1993) and Hinze (1996).

Ardmore basins at the Wichita Magmatic Province. Depths to crystalline rock in the Anadarko Basin ranges up to 12,192 m (40,000 ft) (Dutton et al., 1982; Johnson et al., 1989). This general south-dipping surface is interrupted by various cratonic basins, most of which are interpreted as having been formed during the Paleozoic (e.g., Williston, Illinois, Michigan, Salina-Forest City).

There are a number of Proterozoic cratonic fold and fault zones interpreted by Marshak and Paulsen (1996) and Marshak et al. (2000) as the result of late Proterozoic extension that fractured the craton of North America into tectonic blocks and later served as zones of weakness for Phanerozoic inversion, transpression, and transtensional faulting. These trends are predominantly oriented in two directions; north to northeast, and east to southeast. Structural influences on initial Phanerozoic sedimentation were predominantly extensional (Marshak and Paulsen, 1996), resulting from Proterozoic to Eocambrian rifting at numerous locales in the craton. Extension was supposedly caused by the late Proterozoic rifting.

Uniformitarian Precambrian history is presented as the gradual accretion of the continents during the Archean and Proterozoic by plate tectonic processes. Thus, the Midcontinent basement is divided into distinct provinces (Figure 5), grouped on the basis of isotopic dates (Van Schmus et al., 1993; 1996) and inferred plate tectonic history. These include:

Superior and Wyoming Provinces	Up to 3600 Ma
Central Plains Orogen	
North	1800–1700 Ma
South	1700–1600 Ma
Trans-Hudson Orogen	1880–1830 Ma
Penokean Orogen	1880–1830 Ma
Southern Granite Rhyolite Province	1370 Ma
Eastern Granite Rhyolite Province	1470 Ma
Llano Province	~1200 Ma
Grenville Province	1240–800 Ma

The core of the Precambrian North American craton is the Archean to early Proterozoic Superior Province (also called the Hudsonian craton). It extends south from Canada into the Dakotas where it is bounded by the north-south trending Trans-Hudson orogen (Figure 5). On the west side of this orogen, the Wyoming Province extends into northeastern Nevada. The Superior Province is truncated in the southeast by the Grenville province. South of the Superior Province, in Iowa, Wisconsin, Michigan, and Ontario, lies the 1.85 Ga Penokean orogen, a region of deformed and metamorphosed rock.

The Central Plains orogen (Sims, 1990; Sims and Peterman, 1986) is more than 1000 km long and 500 km wide, and is delineated based on basement drilling and geophysical data from several states. It is a broad curving belt of metamorphic and granitoid rocks that extends from Missouri into exposed sections of equivalent rocks in Colorado and Wyoming, but is currently undefined in the eastern midcontinent. It includes an older northern unit (1.8–1.7 Ga) and a younger southern unit (1.7–1.6 Ga). Lithotypes, including metaigneous and metasedimentary rocks, have been described in numerous wells drilled in Kansas, Missouri, and Nebraska, and are described in detail by Van Schmus et al. (1993). Overlying some of the metamorphic rocks of the Central Plains orogen is the Sioux Quartzite, believed to be coeval with the Baraboo Quartzite in Wisconsin.

Rocks in the southern Central Plains orogen are primarily granite, and are known from numerous wells in Kansas, and from less numerous wells in Missouri. Current interpretation (Van Schmus et al., 1993) of these data includes formation of a volcanic-plutonic suite between 1.66 and 1.67 Ga as a possible island arc, which was later intruded by younger (1.62 Ga) granite batholiths. Those portions known from drilling data in northern Kansas are considered to represent the core of the batholith, indicating severe erosion of this part of the crust.

Outboard of the Central Plains orogen lie the south-

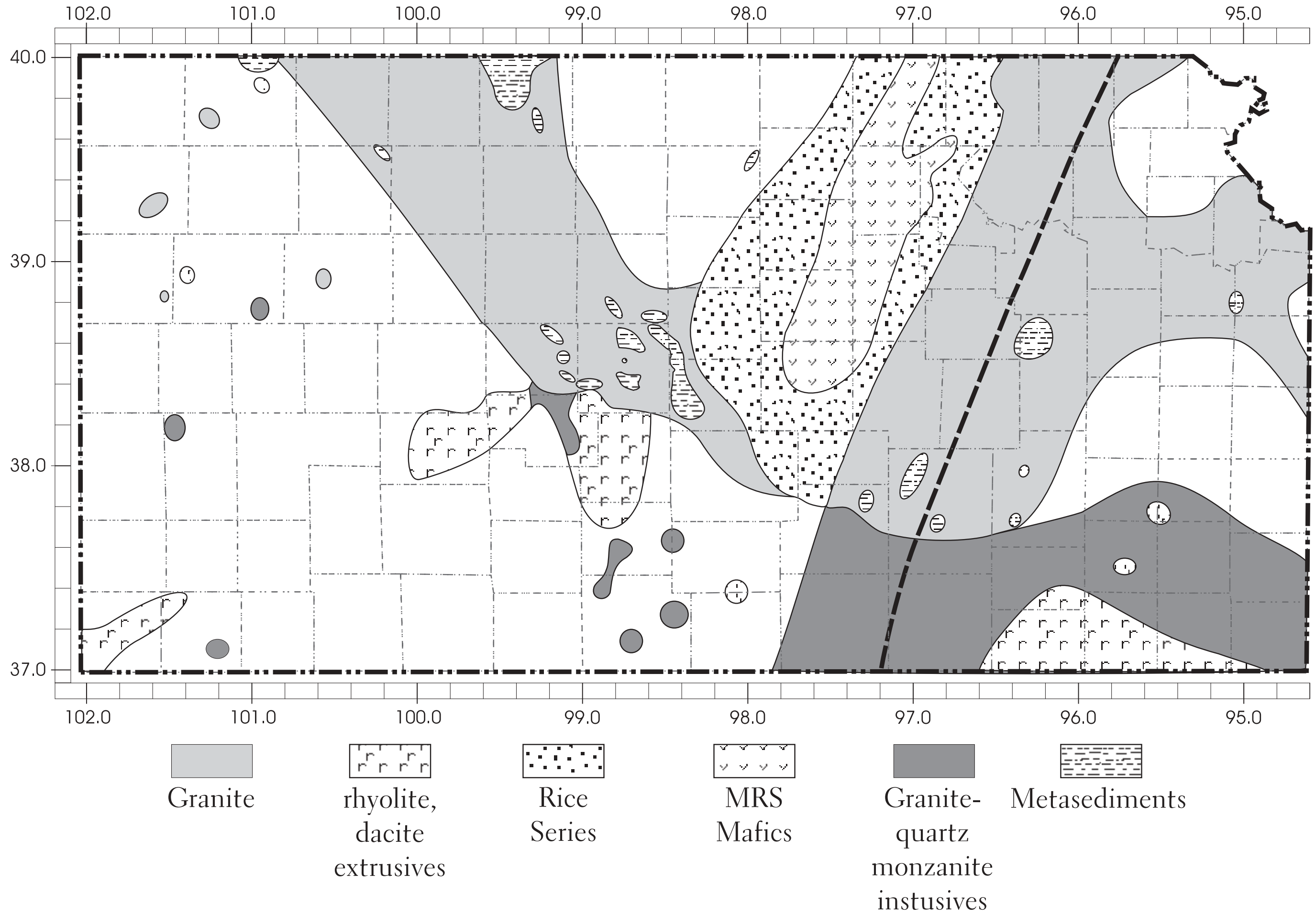

Figure 6. Precambrian subcrop (lithology) in Kansas. From Bickford et al. (1979).

ern and eastern granite-rhyolite provinces. Sm-Nd crustal age data (Van Schmus et al., 1996) lead researchers to believe that much of the granite-rhyolite provinces are veneers covering older crust of the Central Plains orogen. The Southern Granite-Rhyolite Province is a younger unit (1.37 Ga) of epizonal granite and rhyolite. Descriptions come from outcrops in northeastern Oklahoma, and from numerous wells drilled in Oklahoma, Missouri, Kansas, and Texas. Outcrop samples include granophyre (very finely crystalline granite), granite, granodiorite, and equivalent volcanic rocks, with gneissoid rocks in southern Oklahoma. These rocks are chemically and petrographically similar to the Eastern Granite-Rhyolite Province (Figure 5), but are isotopically dated as younger than those 1.47 Ga rocks.

Suites of younger granite plutons intrude rocks of the Central Plains orogen in many locations. There are two age distributions of these plutons that correspond to the Eastern and Southern Granite Rhyolite provinces; circa 1.47 Ga and 1.37 Ga. Some of these plutons can be identified by circular magnetic anomalies with no corresponding gravity anomaly (see Figure 11). Some of these plutons have been confirmed by drilling and range from less than 1 km to greater than 40 km across. The largest, the Red Willow batholith, is located in southwestern Nebraska and northwestern Kansas (Lidiak, 1972).

Morphology and Basement Features

Key features of the Kansas basement include two distinct lithologic/isotopic terranes and several structural/tectonic features. A map of the basement surface in Kansas (Figure 6) shows the Precambrian subcrop at the Cambrian unconformity (Bickford et al., 1979). Additional detail has been added since then at the MRS and Nemaha Tectonic Zone (Berendsen and Blair, 1996), but knowledge of the general morphology of the subcrop remains much as originally mapped by Bickford et al. (1979).

The surface of the Kansas basement ranges from slightly above sea level in the Nemaha Tectonic Zone to almost

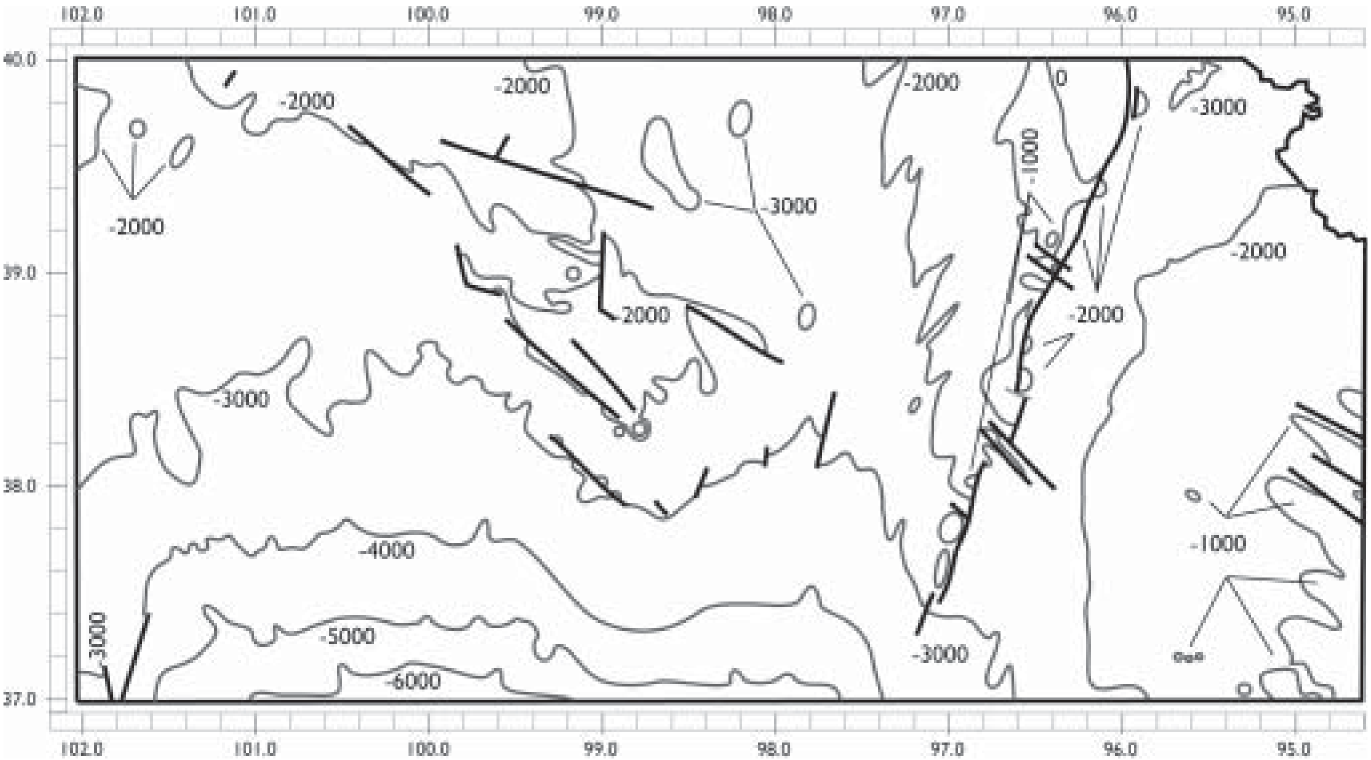

Figure 7. Precambrian subcrop structural surface elevations. After Cole (1976) and Bickford et al. (1979).

-2,134 m (-7,000 ft) subsea at the Oklahoma border (Figure 7). The physiographic surface in Kansas ranges from 207 m (680 ft) to 1,231 m (4,039 ft) above MSL. Xia et al. (1996) report that the structure map of Bickford et al. (1979) has proven generally accurate within the 100 ft. contour interval. In eastern Kansas, the basement dips gently west into the Nemaha Tectonic Zone and north-northeast into the Forest City Basin (Figure 8). This structural trend reflects dip off the roughly circular Ozark Uplift in neighboring southern Missouri, where basement rocks are exposed at the surface. In central and western Kansas, the basement dips to the south towards the Anadarko Basin in southern Oklahoma. The deeper basement in southwestern Kansas forms the Hugoton Embayment of the Anadarko Basin, noted for its extensive natural gas reserves.

The morphology of the basement highlights several other features (compare Figure 8 to Figure 2). The Nemaha Tectonic Zone (also called the Humboldt Fault Zone) runs roughly north-south through eastern Kansas from southeastern Nebraska to southern Oklahoma. Yarger (1983) determined that there was little to no strike-slip component to this fault based on magnetic data. However, the Nemaha Ridge has little gravity expression because the uplifted basement is juxtaposed against sediments of similar density. Steeples (1982) noted that the fault is still active at the present.

In north central Kansas, a basement high forms the Central Kansas Uplift, the southern extension of the Cambridge Arch in Nebraska; both are elements of the Transcontinental Arch. A +25 mgal gravity anomaly in Barton County and a +15 mgal anomaly in Norton County mark the ends of the Central Kansas Uplift (Figure 9). Between the Nemaha Tectonic Zone and the Central Kansas Uplift lies the Salina Basin, and to the east of the Nemaha Tectonic Zone lies the Forest City Basin. A +15 mgal anomaly in Republic, Smith, Jewell, and Mitchell counties (see Figure 1 for county locations) likely results from mafic rocks intruded at depth beneath the Salina Basin. Lam (1986) speculates that these mafics are related to the basin's origin.

Similarly, Yarger (1983) concluded that an arc of intrusives in the southern half of the Forest City Basin marks a zone of weakness that led to later Paleozoic basin deformation. They appear as roughly circular magnetic anomalies up to 14.5 km (9 miles) in diameter in northeastern Kansas. Several have been drilled and cored, confirming the presence of epizonal granite with up to two percent magnetite (Steeples and Bickford, 1981).

The Cherokee basin is found in southeastern Kansas, separated from the Forest City Basin by the Bourbon Arch (Figure 1). The Pratt Anticline separates the Hugoton

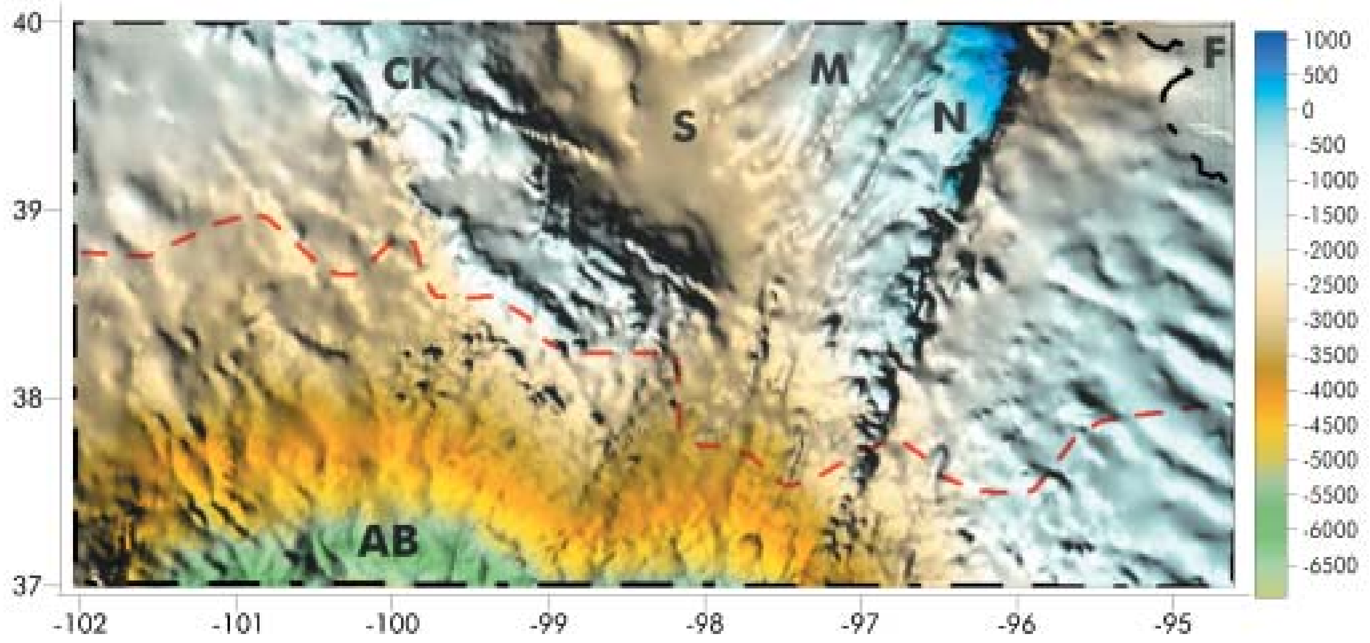

Figure 8. Precambrian basement surface showing 3-D elevation. AB = Anadarko Basin, CK = Central Kansas uplift, S = Salina Basin, M = Midcontinent Rift, N = Nemaha Uplift, F = Forest City Basin. Red dashed line shows boundary between northern and southern terranes according to Xia et al. (1995). Map axes are labeled in accordance with the unprojected latitude/longitude grid used. Based on Bickford et al. (1979).

Embayment and the Sedgewick Basin in south central Kans. (Newell et al., 1987). The Las Animas Arch is located in the northwest corner of the state, adjacent to the Central Kansas Uplift.

Thickness and Depth of the Phanerozoic Sedimentary Cover

The Kansas Geological Survey published cross sections of the Phanerozoic sedimentary cover in the state. These are shown in Figure 10, as east-west lines across the entire state, arrayed from north to south.

The below ground depth to Phanerozoic sediment ranges from 201 m (660 ft) in northeastern Kansas over the Nemaha Uplift (Xia, 1992) to 2,999 m (9,840 ft) in Meade County, southwest Kansas. According to uniformitarian geologists, the oldest dated outcropping sediments in Kansas are Mississippian in far southeastern Kansas (Ross, 1991). The cross sections show a general thickening of sediments to the south (Anadarko Basin) and west (Denver Basin). The general18 absence of pre-Mississippian strata atop the Central Kansas Uplift and the Nemaha Tectonic Zone is cited as evidence of erosion during late Mississippian to early Pennsylvanian time (Rascoe and Adler, 1983).

Line 2 of Figure 10 shows the crustal thickening of crystalline rocks across western Kansas, supported by the Bouguer gravity anomaly map (Figure 9) that reveals decreasing gravity readings across the same area. Gravity data (Lam, 1986) agrees with seismic refraction data, and support a westward increase in the depth of the base of the crust at the Mohorovicic Discontinuity from 38 km (23.6 miles) in north-central Kansas to 48 km (29.9 miles) in western Kansas.

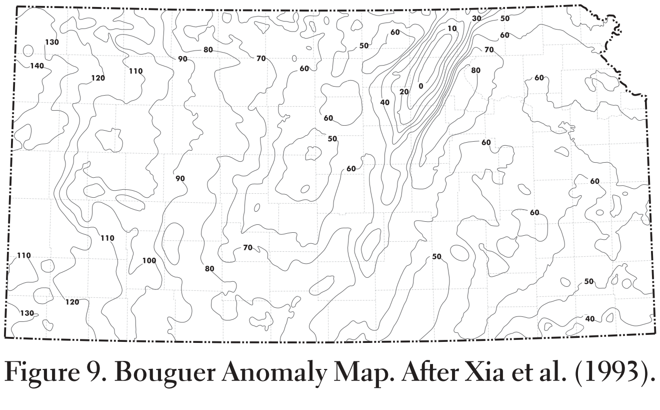

Figure 9. Bouguer Anomaly Map. After Xia et al. (1993).

Basement Terranes

The crystalline basement in Kansas has been divided into two distinct terranes—north and south (Figure 11) at a line running roughly across the southern third of the state (Bickford et al, 1981; Yarger, 1983; Sims, 1990; Van Schmus et al., 1993; Xia et al., 1995). The two terranes are distinguished lithologically, texturally, geophysically, and isotopically. The northern terrane is assigned to the southern Central Plains Orogen and the southern terrane is the northern part of the Southern Granite-Rhyolite Province that extends into Oklahoma and the Texas panhandle (Van Schmus et al., 1993). The northern terrane is composed primarily of mesozonal granite and metamorphic rocks; the southern terrane primarily of epizonal granite and rhyolite (Yarger, 1983; Lam, 1986). The southern terrane has an isotopically younger age, overlies thinner crust or lithosphere, has a higher geothermal gradient, and is more ductile (Bickford et al., 1981; Yarger, 1983; Lam, 1986).

Both terranes are composed primarily of granitic rocks; mafic and intermediate igneous rocks are uncommon outside of the MRS. Of the wells that penetrated the basement and were drilled prior to 1985 (Cole and Watney, 1985), 31% encountered granite and 39%, granite wash, often then penetrating underlying granite. Another 23% encountered metamorphic rock, predominantly quartzite, and 2% encountered arkosic sediments. Another 2% encountered rhyolite and 1% encountered basic igneous rocks.

The nature of the boundary between the two terranes is unknown. Earlier researchers (e.g., Anderson and Black, 1982) favored a rifting event, but Van Schmus et

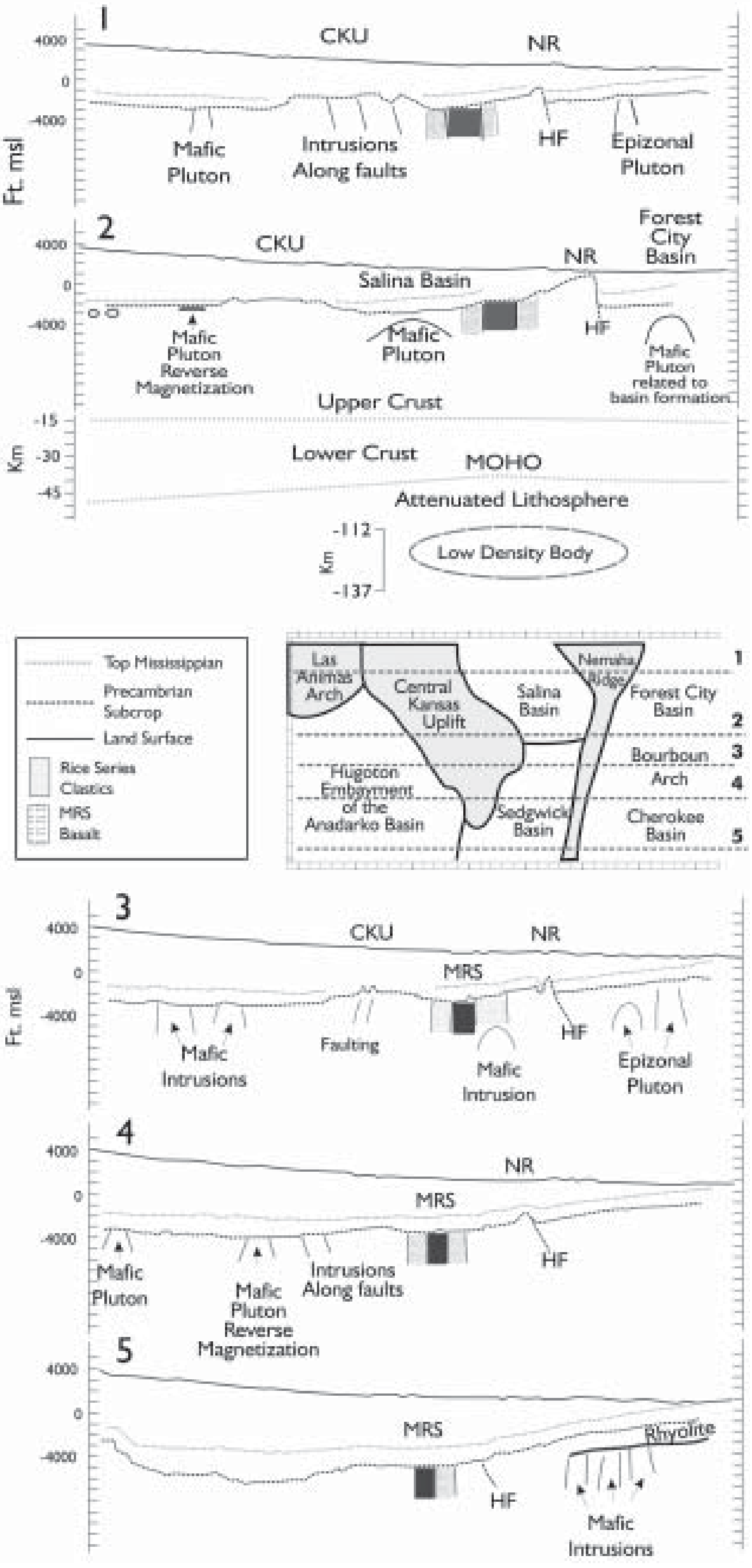

Figure 10. Cross sections of the Phanerozoic cover of Kansas. CKU is Central Kansas Uplift, MRS is Midcontinent Rift System, and NR is Nemaha Ridge. After unreferenced Kansas Geological Society publication.

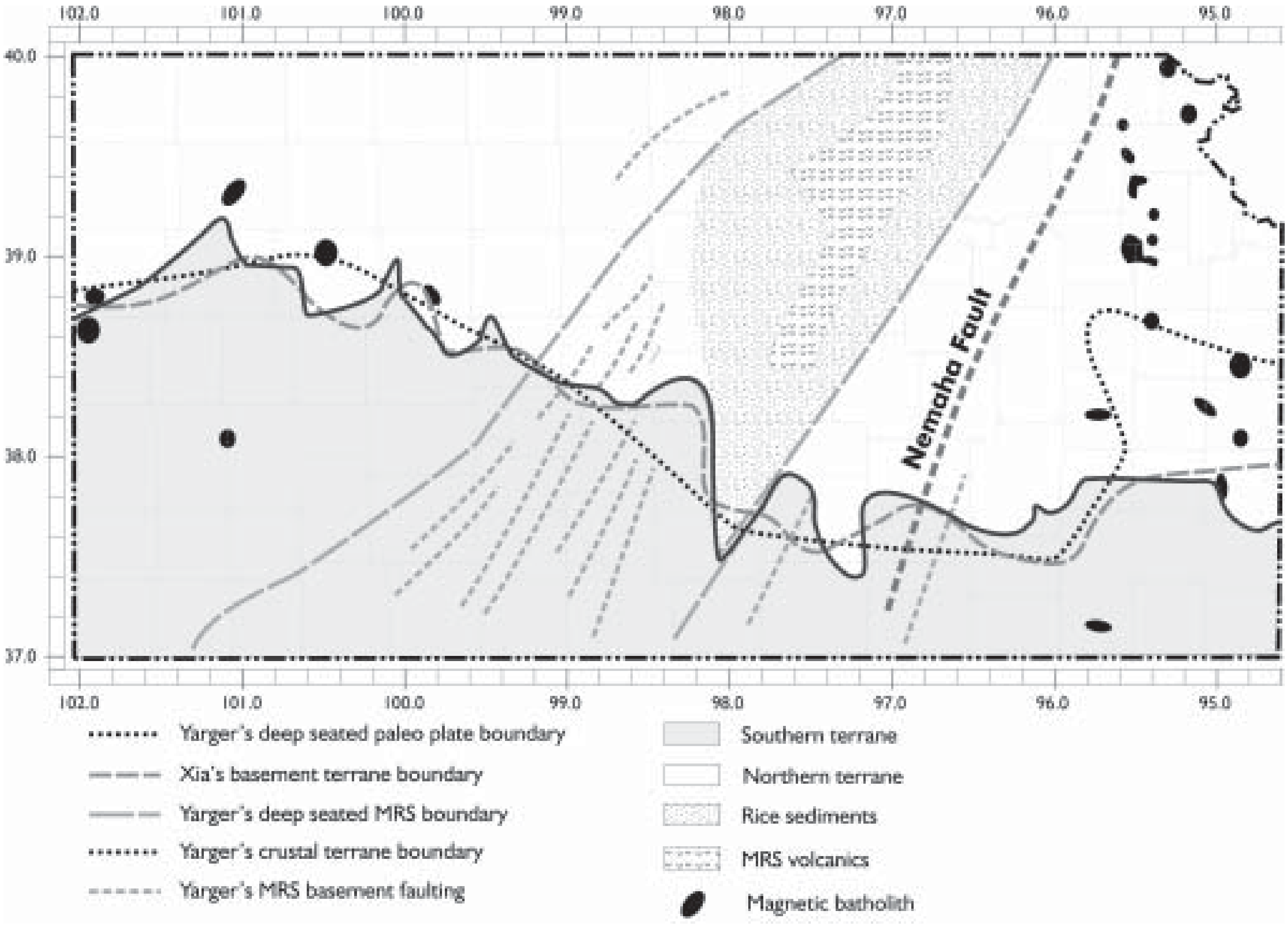
102.0
101.0
100.0
99.0
98.0
97.0
96.0
95.0
40.0
39.0
38.0
37.0
Nemaha Fault
Yarger's deep seated paleo plate boundary
Xia's basement terrane boundary
Yarger's deep seated MRS boundary
Yarger's crustal terrane boundary
Yarger's MRS basement faulting
Southern terrane
Northern terrane
Rice sediments
MRS volcanics
Magnetic batholith

Figure 11. Basement terrane boundaries in Kansas. Modified from Yarger (1983) and Xia (1995).

al. (1986), Bickford et al. (1986), and Lam (1986) proposed an anorogenic intrusive event, possibly associated with a proposed 1.4 Ga subduction zone at the Llano front in Texas. Gravity data suggest that the differences between the two terranes are in the upper crust, and that the lower crust is similar in both.

Intruded into both terranes are epizonal plutons, visible as roughly circular magnetic anomalies. Several of these have been drilled and cored, confirming lithology and composition (Steeples and Bickford, 1981). Isotopic dates of these rocks are reported to be slightly younger than those of the southern terrane. Lam (1986) noted a +30 mgal gravity anomaly in Montgomery, Cherokee, and Labette counties with small positive closures. He interpreted the anomaly as rhyolite basement (less dense than granite) and concluded that the small closures were feeder pipes with more dense mafic rocks.

Northern Terrane

The northern terrane is defined by the presence of sheared igneous (primarily granitic) and metamorphic rocks (mostly metasedimentary). Granites are composed of zoned plagioclase, quartz, potassium feldspar, biotite, and accessory minerals such as zircon, sphene, apatite, and magnetite. The sheared texture is visible in fractures, shear zones, offset twin lamellae, brecciation, partially recrystallized cataclastic textures, polycrystalline quartz aggregates, and patches of myrmekite. They are age-dated at approximately 1630 Ma, some 100–200 Ma younger than equivalent exposed rocks in the front range of the Rocky Mountains (Van Schmus et al., 1993). Included in the sheared granites are bodies of younger granite (1.48–1.34 Ga [Bickford et al., 1981]) some of which are sheared and some of which are not.

Magnetic anomaly maps (Yarger, 1983) also reveal

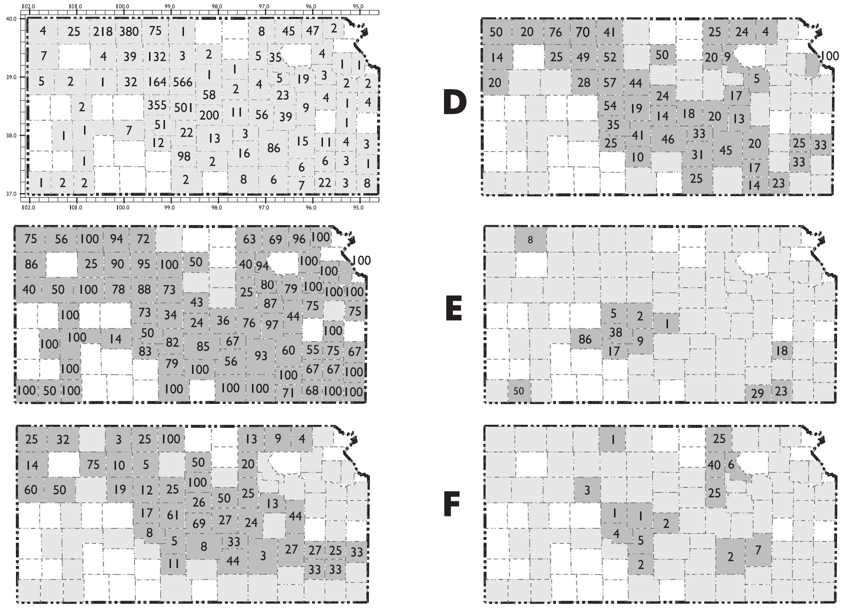

Figure 12. Basement lithology by county based on well penetrations. A = base map showing number of wells penetrating basement drilled in each county prior to 1985, B = percentage of wells encountering granite or granite wash, C = percentage of wells encountering metamorphic rocks, D = percentage of wells encountering granite wash, E = percentage of wells encountering rhyolite, F = percentage of wells encountering basic igneous rocks. Data from Cole and Watney (1985).

roughly circular bodies that contain higher than normal percentages of magnetite. Limited samples from these bodies have been dated at similar ages to southern terrane granites, but they lack granophyric intergrowths found in southern terrane granites.

Although many wells drilled in the northern terrane encounter granite and granite wash, a significant number of others penetrated metamorphics, mostly quartzites and schist (Figure 12). Quartzites are coarse-grained with anhedral quartz grains having sutured boundaries. Their texture suggests high-grade metamorphism, but a corresponding diagnostic high-grade metamorphic mineralogy is absent. The only sampled metamorphics with such mineralogy occur in Phillips and Norton counties near Nebraska. The metamorphic basement samples are interpreted to be the remnant of Precambrian weathering and erosion—only resistant quartzite remains.

Southern Terrane

The southern terrane samples are primarily unmetamorphosed rhyolitic and dacitic rocks, and granite of the same composition. The granite is epizonal, granophyric to micrographic, and medium grained (3–5 mm). The mineralogical composition (with rough percentages) is quartz (35%), perthite (40–45%), sodic plagioclase (15%), biotite (<5%), and accessory minerals of magnetite, sphene, apatite, and zircon. These rocks are age-dated at 1.48–1.34 Ga.

Approximately 90% of the volcanic rock samples are rhyolite with phenocrysts of plagioclase, perthite, and quartz (30–40%), and a groundmass of quartz and plagioclase. These rocks are interpreted as originating as ash-flow tuffs (Bickford et al., 1979), based on limited evidence. Two large fields near the southern junction of the Central Kansas Uplift and the MRS (Figure 6) show textural evidence of ash-flow tuffs. However, igneous rocks in the basement do not match modern examples of plate tectonic boundaries because they have no mafic or intermediate members or rift zones with bimodal suites and mafics.

The structural fabric of the southern terrane is divided into an eastern and western segments by the Nemaha Ridge fault zone, which juxtaposes mesozonal granite on the upthrown west side with epizonal granite on the downthrown east side (Bickford et al., 1979); now shown on Sims (1990) map). The southern Nemaha fault zone is similar, but it lacks the graphyric texture and has slight to moderate cataclastic texture. It is identified as mesozonal because of the texture, but a definitive identification is not available.

Acknowledgements

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Glossary

Arkose: A feldspar rich sandstone, commonly angular and poorly sorted, usually derived from granite or granitic rock.

Dacite: A fine-grained extrusive rock, the extrusive equivalent of andesite.

Epizonal: Referring to conditions of low metamorphic grade.

Gneissoid: Exhibiting the textural or foliated structure of a gneiss, yet not generated by metamorphic processes.

Granophyric: Referring to the texture of a porphyritic igneous rock in which the groundmass and phenocrysts penetrate each other as a result of simultaneous crystallization.

Graphyric: Referring to a granophyric texture in a rock in which the clasts are of microscopic size.

Mesozonal: Referring to a medium to high metamorphic grade.

Micrographic: Referring to the microscopic texture of an igneous rock in which the feldspar and quartz are intergrown.

Peridotite: A coarse-grained plutonic rock composed primarily of olivine with other mafic minerals.

Perthite: An alkali feldspar with visible intergrowths of potassium rich feldspar and sodium rich feldspar.

Rhyolite: A fine grained silicic volcanic rock; the extrusive equivalent of granite.

Xenolith: An inclusion in an igneous rock of different composition and texture.

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An Old Age for the Earth Is the Heart of Evolution

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Abstract

An accommodationist claim about chronology runs something like this: "Even if it could be shown that the earth is young (which it is not), that would be irrelevant to the chronology of the universe, because there are independent evidences that the universe is as old as evolution says it is. Furthermore, the age issue is not really important." Such statements are not true. The centrality of long ages to evolutionary thought has long been emphasized. Further, the supposed evidences of the vast antiquity of planets, stars, galaxies, and the universe ultimately rest on the belief in the evolutionary age of the earth. The long chronologies for the universe and its parts are therefore not independent of the alleged old age of the earth. If the earth is shown to be young, the evidence for an old universe crumbles.

Time Is the Central Requirement for Evolution

Old-universe apologist Hugh Ross writes that "age need not even be an issue" in discussing origins (Ross, 1994, p. 10), and maintains that "the age of the universe and of the earth" is a "peripheral point" (Ross, 1994, p. 8). On the other hand, decades ago astrophysicist Arthur S. Eddington acknowledged the absolute primacy of time, without which evolution would be impossible and inconceivable: "Looking back through the long past we picture the beginning of the world—a primeval chaos which time has fashioned into the universe that we know" (Eddington, 1930, p. 11). Such a statement could be taken to imply that time has supplanted the Creator. Since this remains the conventional perspective of the function of time in cosmic evolution, it follows that the age issue implicitly enters into virtually all evolutionary theorizing.

Eddington was not only an eminent scientist but a well known popularizer of science, especially astronomy. He repeatedly stated his belief in the centrality of time for naturalistic development. In the evolution—or the "becoming"—of the universe, he wrote, "Time occupies the key position" (Eddington, 1933, p. 91). As with Eddington, Carl Sagan acted not as an originator of chronological thought, but as an advocate of the primacy of time in evolution. Sagan also described the evolution of the universe with "time" replacing God as the First Cause:

> For unknown ages … there were no galaxies, no planets, no life. …A first generation of stars was born. …In the dark lush clouds between the stars, smaller raindrops grew, bodies far too little to ignite the nuclear fire…Among them was a small world of stone and iron, the early Earth. …One day a molecule arose that … was able to make crude copies of itself … life had begun. Single-celled plants evolved … plants and animals discovered that the land could support life. …[Some animals] became upright … emerging into consciousness. At an ever-accelerating pace, [consciousness] invented writing, cities, art and science, and sent spaceships to the planets and the stars. These are some things that hydrogen atoms do, given 15 billion years of cosmic evolution (Sagan, 1980, pp. 337–338).

If to Sagan time was the "creator" which brought the universe into existence, planetary astronomer William K. Hartmann has expressed the same idea, namely, that time is really the only necessity for evolution—a "long" time:

> From all we have just said, we conclude that if planetary surfaces with the necessary conditions—liquid water and the 'CHON' chemicals (carbon, hydrogen, oxygen, and nitrogen)—exist long enough anywhere, life is likely to evolve (Hartmann, 1991, p. 621).

With time as the evolutionary agent, it is no wonder that the evolutionary expectation of finding extraterrestrial life has over the decades gone from disrepute to popular acceptance (Henry, 2002, p. 170). On the other hand, without sufficient time, evolution, nature's "self-realization," would not happen at all (Easterbrook, 1996, p. 48).

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Evolutionary Chronology Is Tied to the Age of the Earth

All evolutionary cosmic ages are in the final analysis based on an old age for the earth, so if this chronology is destroyed for the earth, it is demolished for the cosmos as well. The sun is thought to be old because the earth is old, other stars are thought to follow a mode of operation and chronology based on that of the sun (Bahcall, 1990, p. 56; Fix, 1999, p. 385), and the Hubble constant and the age of the universe are adjusted in an attempt to make the cosmos older than the stars (Goldsmith, 1985, p. 115).

Coming back to the solar system, the moon is assumed to be slightly older than the oldest rocks on earth, and the solar system is dated from meteorites on the assumption that it is older than both the earth and the moon (Goldsmith, 1985, p. 366). Cratered planets such as Mercury are dated by comparison with the moon (Hubbard, 1984, p. 197). Indeed, it is generally true that "the relationship between crater density and age determined for the Moon has been used to estimate the ages of other planets and satellites" (Fix, 1999, p. 188). This chain of chronological reasoning would be logical were it true that first some meteorites formed out of the putative solar nebula, then moons and planets (Whipple and Green, 1986, p. 222; Hubbard, 1984, p. 9; Norton, 1998, pp. 349-350). Further, it is not true that meteoritic dating points unambiguously to a 4.5 billion year age for the solar system (Gariepy and Dupre, 1991, pp. 216–217; Williams, 1992, p. 2).

The chain of chronological reasoning traced above is not based on actual observation, but on inference, a fact pointed out occasionally:

> Many things loosely described as scientific 'facts' are not really facts at all. For example, you might have the impression that this book stated the 'fact' that the universe is between 10 and 20 billion years old. But such a usage of the word 'fact' is really just a habit of speech that is seen to be imprecise on close examination. In reality, the age astronomers assign to the universe is an *inference* from the large amount of observational data that we have [emphasis in original] (Robbins, 1988, p. 445).

In other words, there are no data compelling the acceptance of evolutionary ages, but researchers have reached the conclusions they wanted to believe.

Over the last century and a half, physicists and astronomers eventually accommodated themselves to geological dates for the age of the earth, readjusting their cosmic and stellar dates so as not to conflict with terrestrial claims. Physicists as well as astronomers were tying their chronologies into the evolutionary time frame for the earth:

> The conflict between physics and astronomy over the Age of the Earth was resolved in the 1950s. …[T]he conflict between physics and geology … had ended 50 years earlier with a complete reversal by the physicists [in favor of geological dates for the earth]; this time it was the astronomers who revised their estimates and suddenly switched to a much longer time scale [to avoid conflict with the geologists]. They had decided that Hubble had underestimated the intrinsic luminosities of distant stars and the Cepheid variable scale of distances had to be recalibrated; together the two corrections [read: adjustments] expanded the time scale by a factor of 4, with further increases to come in subsequent decades. By the mid-1980s, estimates of the age of the universe generally ranged from 10,000 to 20,000 m.y., safely beyond the estimates of the Age of the Earth, which had stabilized at 4500 to 4600 m.y. …According to David Raup, *one result of this episode is that 'geology has a curious moral authority over astrophysics'*… [emphasis added] (Brush, 1989, p. 173).

The first widely-accepted rationale for radiometric dating of the earth was put forward by T.C. Chamberlain. He based his estimates on the putative time for biological evolution, saying that his view "takes due account of biological requirements" (Brush, 1989, p. 172), meaning that the presumed age of the earth for biological evolution had to be consulted before radiometric dates could be selected to "confirm" this old age. Richard Milton, who is not a young earth advocate, nevertheless points out that the readiness to reject radiometric dates except those giving "expected values" is why various radiometric methods can be claimed to converge in the "ages" they "measure" (Milton, 1997, p. 49):

> Thus the published dating figures *always* conform to preconceived dates and never contradict those dates. If all the rejected dates were retrieved from the waste basket and added to the published dates, the combined results would show that the dates produced are the scatter that one would expect by chance alone [emphasis in original] (Milton, 1997, p. 51).

Woodmorappe (1999, pp. 1, 6) makes the same observation.

Evolution Dates the Sun by the Evolutionary Age of the Earth

Evolution asserts that the earth is billions of years old. Astronomers for several generations have stated that this is the only real reason the sun is believed to have an age of billions of years. In the 1920s Eddington wrote,

> Formerly the contraction theory of Helmholtz and Kelvin held sway. This supposes that the supply [of the sun's energy] is maintained by the conversion of gravitational energy into heat owing to the gradual contraction of the star. The energy obtainable from contraction is quite inadequate in view of the great age now attributed to the sun (Eddington, 1926, p. 289).

And why did Eddington view solar contraction as insufficient to supply the sun's energy output over the sun's lifetime? Because, "It is not much use extending the age of the earth without extending the age of the sun" (Eddington, 1926, p. 295). In other words, as the evolutionary age of the earth expanded in the early twentieth century, the supposed age of the sun expanded to keep pace.

Whatever actually occurs in the sun—whether fusion only, or fusion with a degree of contraction—the sun's presumed age is based ultimately on the alleged age of the earth. Eddington made this point repeatedly: "Geological, physical, and biological evidence seems to make it certain that the sun has warmed the earth for more than a thousand million years [now taken to be some 5 billion years]" (Eddington, 1959, p. 162). In context, the "physical" evidence to which Eddington referred was nothing more than the supposed geological and biological "evidence" that the earth is old. Eddington was explicit about this:

> On such an important question we should not like to put implicit trust in [astronomical arguments] alone, and we turn to the sister sciences for other and perhaps more conclusive evidence. …The age of the older rocks [of the earth] is found to be about 1,200 million years. …The sun, of course, must be very much older than the earth and its rocks (Eddington, 1929, p. 96).

The evolutionary ages of the oldest terrestrial rocks have expanded since Eddington's time from 1.2 billion years to some 3.8 billion years (Milton, 1997, p. 17).

Two generations ago, physicist and science popularizer George Gamow described the same dependence of solar dating on the evolutionary age of the earth: "Our sun is now only about 3 or 4 billion years old…" And the reason for this age?—"…since the estimated age of our earth is of that order of magnitude" (Gamow, 1953, p. 301). The same logic for dating the sun at billions of years continues to this day:

> By the end of the nineteenth century, geological evidence had increased the estimated age of the Earth to several *hundred* millions of years, and the discovery of radioactivity at the close of the century made it possible to measure the Earth's age with even greater certainty at around 4.5 *billion* years. …[It] is hard to imagine how the Earth could be much older than the Sun [emphases in original] (Robbins, 1988, p. 295).

Indeed, this rationale for dating the sun has been commonly acknowledged: "The Sun's age was measured at 4.6 billion years by dating planetary matter" (Hartmann, 1991, p. 381). Hartmann has worded this statement in such a way as to imply that evidence from outside the earth confirms the sun's old age, but this statement is misleading, for in context the "planetary" material to which he refers is nothing more than the rocks of the earth. In a more forthright assessment, astronomer John Fix says,

> Geologists have found rocks 3.5 billion years old that contain fossils of marine organisms. These discoveries clearly demonstrate that the Sun has warmed the Earth for at least 3.5 billion years and probably for as long as the Earth has existed (Fix, 1999, p. 386).

Researchers are sometimes objective about the faulty reasoning illustrated in the preceding paragraphs. Solar expert John Eddy stated that,

> I suspect that the Sun *is* 4.5-billion years old. However, given some new and unexpected results to the contrary, and some time for frantic recalculation and theoretical readjustment, I suspect that we could live with Bishop Ussher's value for the age of the Earth and the Sun. I don't think we have much in the way of observational evidence in astronomy to contradict that. Solar physics now looks to paleontology for data on solar chronology [emphasis in original] (Kazmann, 1978, p. 18).

This is a staggering statement, for Eddy admitted that there is really no hard evidence that the sun is very old. Indeed, Eddy went so far as to propose the possibility of returning to Ussher's chronology which puts creation at 4004 BC. Since Eddy's last sentence quoted above claims that evolutionary solar chronology depends on "paleontology," Eddy has again affirmed that the conventional age of the sun is based ultimately on nothing more than the presumed evolutionary age of the earth.

Evolution Dates the Solar System and Universe by the Evolutionary Age of the Earth

Hartmann claims that, "The age of the solar system is 4.6 Gy [billion years]. This figure has been derived from studies of rocks from three planetary sources: the meteorites … the moon, and Earth" (Hartmann, 1983, p. 119). There appear to be three independent dating sources (the meteorites, the moon, and the earth) referenced here, but in fact the age of the moon is worked out to agree with the earth's alleged age (Hammond, 1974, p. 911; Fix, 1999, p. 186), and that of meteorites is worked out to be slightly older than the earth (Fix, 1999, p. 335). This may appear surprising, since these chronologies are based on radiometric dating results, but the fact is that,

> In general, dates in the 'correct ball park' are assumed to be correct and are published, but those in disagreement with other data are seldom published…(Mauger, 1977, p. 37).

There is thus a concentration of accepted radiometric dates around the values preconceived as being correct, for such "figures are obtained by omitting, with no objective reason, the much broader deviations" (Waterhouse, 1979, p. 499). The apparent convergence of radiometric dating results is more a chimera than reality because "many age determinations which do not agree with currently accepted time scales are simply rejected as wrong…" (Paul, 1980, p. 184). Even for the currently popular neodymium/samarium dating method, "In the majority of cases the ages are off and the [discrepant] data disappear in a lab-datafile" (Jagoutz, 1994, p. 156). When all is said and done, the age of the earth remains the chronological baseline for evolution. More will be said about meteoritic dating of the solar system and the earth below.

Chronologies for other planets such as Mars may be worked out by comparison with the assumed lunar chronology (Short, 1975, pp. 246, 248), but since the lunar chronology is based on the presumed age of the earth, such chronologies are not truly independent. Nonetheless, such chronologies have been entrenched for many decades, and it has become common to speak of them as if they are independent verifications of evolutionary ages (Podosek, 1999, pp. 1863–1864). A recurrent phenomenon in the history of science is that a paradigm becomes so widely accepted that the basic assumptions behind it are no longer questioned, and the paradigm is taken as virtually self-evident truth (Kuhn, 1970, pp. 10–11). This appears to have come to pass in general with evolutionary chronologies. In such a situation, there may be the appearance of vigorous debate, but the debate is actually constrained within "safe" boundaries so as to leave the paradigm untouched (e.g., asking whether primordial meteoritic material is 4.55 or 4.65 billion years old, but *not* questioning whether the range of ages under discussion has any validity). To expose fundamental fallacies of the paradigm is nearly always unacceptable (Kuhn, 1970, pp. 15–21, 37, 77-78, 177).

In dating the conventional age of the cosmos, the presumed size of the universe is the only "evidence" of its age: "… its size is inextricably bound up with its age. The Universe is fifteen billion light years in size because it is fifteen billion years old" (Barrow and Tipler, 1986, p. 3). But the estimated size of the universe is tied to the presumed expansion rate allegedly due to the putative Big Bang. The quantity employed to describe the rate of expansion is the Hubble constant (Fix, 1999, pp. 600–601; Pasachoff, 1985, p. 261). It might seem as if we have in the Hubble constant at last a truly independent dating method, but in fact the size of the Hubble constant is evaluated to give an expansion time (or age) which is proportional to the evolutionary age of the earth: "By using the Hubble relation, and working backward in time, the time of the big bang can be estimated" (Kornberg, 1978, p. 10). If this last point seems questionable, consider the following.

When the Hubble constant was initially evaluated, the "upper limit" age it gave was too small to satisfy evolutionary geologists:

> Unfortunately, the reciprocal of Hubble's constant gave an age for the universe of only 1.8 billion years. Rocks on earth were then already known to be as old as 3.0 billion years. Obviously, the universe could not be younger than the earth (Kornberg, 1978, p. 10).

Once again, a supposedly independent evolutionary chronometer works out in reality not to be independent, but is tied back to an old age for the earth. Indeed, the Hubble constant has been changed by a factor or four or more since the 1920s (Brush, 1989, p. 173; DeYoung, 1995, p. 9), a revision which has corresponded to evolutionary inflation of the age of the earth (De Vaucouleurs, 1970, p. 1204). On the other hand, though at one time the earth's evolutionary age was predicted by some to be almost indefinitely inflatable (De Vaucouleurs, 1970, p. 1204), it settled at around 4.5 billion years. This completed the chronological paradigm shift initiated primarily by Charles Lyell a century and a half earlier in the 1830s (Milton, 1997, p. 77; Easterbrook, 1996, p. 77).

Evolution Has Dated the Earth by Arbitrary Uniformitarian Assumptions

If the evolutionary age of the earth were valid, then the evolutionary chronologies depending on the earth's age might be valid as well. However, the earth's evolutionary age has been established by invoking arbitrary assumptions. Physicist George Gamow described how the earth's age was set:

> Thorium and the common isotope of uranium

> (U^{238}) are not markedly less abundant than the other heavy elements. …Since the half-life periods of thorium and of common uranium are 14 billion and 4.5 billion years, respectively, we must conclude that these atoms were formed not more than a few billion years ago. On the other hand … the fissionable isotope of uranium (U^{235}) is very rare, constituting only 0.7 percent of the main isotope. …The half-life of U^{235} is considerably shorter than that of U^{238}, being only about 0.9 billion years. Since the amount of fissionable uranium has been cut in half every 0.9 billion years, it must have taken about seven such periods, or about 6 billion years [now taken to be 4.5 billion years], to bring it down to its present rarity, if both isotopes were originally present in comparable amounts (Gamow, 1952, pp. 15–16).

Evolutionist (but anti-Darwinian) Richard Milton has summarized essentially the same argument: "[If] a deposit was composed of half uranium 238 and half its daughter product lead 206, then one would draw the conclusion that the deposit was 4,500 million [4.5 billion] years old. [This] is the average figure that is found for the Earth's crust" (Milton, 1997, p. 41). There are two arbitrary assumptions in this reasoning. It can never be known that the pairs of isotopes in question were ever present on earth in comparable amounts, as both Gamow and Milton assume. Further, the mere occurrence of radioactive decay implies nothing about how long it has been happening. This is the fallacy of confusing the time to complete a process with the interval over which the process has been occurring. The truth is that evolution needs the earth to be old, so assumptions have been selectively and arbitrarily chosen to make the earth appear old. Indeed, Gariepy and Dupre (1991, p. 216) have emphasized that "in all ancient rocks" it is impossible to know the initial abundance of uranium isotopes "since uranium is easily remobilized"; i.e., uranium minerals are transported by natural processes the effect of which is impossible to evaluate over the history of the earth.

One of the earliest attempts to derive the age of the solar system from meteoritic data, and by extension, the age of the earth, was described by Patterson (1956, p. 230), updated by Huey and Kohman (1973, pp. 3228–3229) using revised radioactive decay constants, and more recently described by Allegre et al. (1995, p. 1445). Patterson's result of 4.55 ± 0.07 billion years was based on a whole-rock isochron (Patterson, 1956, p. 231; Faure, 1986, p. 312) for five meteorites. In fact, Patterson's result was tied to lead isotope levels in Pacific Ocean sediments, so that ultimately assumptions sediment characteristics entered into Patterson's analysis. The characteristics of the sediments were predicated in turn on the supposed evolutionary history of the earth.

It has more recently been shown that meteorites do not always give evolutionary dates agreeing with those of Patterson (Gale et al., 1972, p. 57; Minster et al., 1982, p. 414). This has led to the assertion that, contrary to the assumptions discussed above and advocated by Patterson (1956, p. 235), lead isotopes were not mixed uniformly in the material from which the meteorites came (Tatsumoto et al., 1973, p. 1282; Abranches et al., 1980, p. 311; Gariepy and Dupre, 1991, p. 217). More recent assessments of ocean sediment data have shown that even these do not produce dates in agreement with the whole-rock isochron results (Zindler and Hart, 1986, pp. 507–508), leading to the assumption that there must be an as-yet undiscovered reservoir of lead isotopes within the earth's interior. Despite the evident uncertainty in the assumptions of Patterson and his successors, Austin (2000, p. 103) has pointed out that in whole rock isochron dating these assumptions continue to be followed. One outcome of the unwarranted adherence to these assumptions is the emergence of new problems, such as the missing lead reservoir just mentioned (Gariepy and Dupre, 1991, pp. 216, 224). One suspects that this lead is missing in the same sense that the "missing links" are missing—they never existed but are seen as real in the evolutionary paradigm because of false conclusions generated by fallacious assumptions.

Because of the problems with dating by whole-rock isochrons, increased attention has been given to dating by generating mineral isochrons of individual mineral grains in rocks. Whereas a whole rock might not meet the assumptions previously discussed, it is felt that individual mineral grains might satisfy them. For example, the Allende chondrite has a number of inclusions high in Ca-Al content (CAIs). Certain CAIs from Allende produced a Pb-207/Pb-206 model age of 4.559 ± 0.004 billion years, relative to the Diablo Canyon troilite, and also formed a linear Pb-207/Pb-206 whole-rock isochron (Tilton, 1989, p. 259). Based on eight selected CAIs, Tera and Carlson (1999, p. 1877) have claimed that these CAIs produce a Pb207/Pb-206 isochron age of 4.558 billion years, thus validating the mineral isochron results and upholding the dates derived by earlier investigators.

However, the Allende matrix and chondrules indicate a younger age, which Tilton (1989, p. 262) minimizes. In addition, Huey and Kohman (1973, p. 3227), by analyzing sixteen chrondrites to assess the age of the solar system, concluded that the age is 4.505 ± 0.008 billion years, less than Tilton's figure. Of course, the view can be taken that results of dating via various isotopes are converging on the true age of the earth. Minster et al. (1982, p. 414) claim that the Rb-Sr whole-rock isochron age is 4.498 ± 0.015 billion years, a date including in its range of uncertainty that of Huey and Kohman (1973, p. 3227). A Sm-Nd whole-rock age of 4.21 ± 0.76 billion years has been obtained (Jacobson and Wasserburg, 1984, p. 141), but this discrepancy is explained by claiming that lack of significant variation of Sm-Nd within chondrites is responsible. Ar-Ar model ages for chondrites yield 4.48 ± 0.03 billion years (Gopel et al., 1994, p. 167), again a discrepancy. The discrepancies appear to be real. This would be expected since these results are based on the questionable assumptions discussed above.

The reliance on unprovable assumptions extends back to the earliest history of radiometric dating. Physicist Ernest Rutherford stated in 1904:

> … for the first time suggested that an exact value [of the age of the earth] might be obtained from a knowledge of the helium content of uranium minerals … [a]ssuming that no helium had escaped from the mineral from the time of its formation … and relying upon the correctness of values for the rate of helium production per gram of radium and the ratio of radium to uranium for minerals wherein equilibrium has been reached…(Badash, 1968, p. 162).

In fact none of these assumptions has been proved for any radiometric method.

In 1905 B.B. Boltwood of Harvard achieved what has been described as “the first results of an accurate radioactive dating technique” using the uranium-lead method, an approach possibly “suggested privately to Boltwood by Rutherford” in correspondence now missing, or when the two scientists met at Yale University in that year (Badash, 1968, p. 163). Interestingly, “Boltwood published … one paper on dating in 1907 and none more,” and even for Rutherford the subject of radiometric dating “was never more than something mildly interesting…Rutherford contributed original research papers on the earth-age problem at the rate of only one each decade, hardly evidence of a consuming interest” (Badash, 1968, p. 165).

Eventually English geologist Arthur Holmes took the mantle of Rutherford and Boltwood, “becoming the leading figure in obtaining wide-spread acceptance of radioactive dating techniques” (Badash, 1968, p. 166), along with T.C. Chamberlain bringing radiometric dating to the status of total acceptance in the non-creationist scientific community. Holmes presented his chronological methods and results in 1913 in his *The Age of the Earth*, and continued to refine his system through the 1930s and 1940s (Badash, 1968, p. 167). Most significantly, however, Holmes’ dates were essentially unchanged from the dates in vogue before the discovery of radioactivity in 1896, let alone before the development of radiometric dating methods. In 1893, based on extrapolation of sedimentation rates, Reade proposed a date of 600 million years ago for the onset of the Cambrian.

In 1931, after Holmes had begun publishing his dates based on radiometric procedures, the observation was made, “Reade’s figures therefore show a rather remarkable agreement with what radioactivity teaches us now” (Schuchert, 1931, p. 21). Indeed, Schuchert believed that “stratigraphy … would provide an important check upon radioactive results” (Burchfield, 1990, p. 205). In other words, despite the development of radiometric techniques, the dates have been changed only slightly. The rhetorical question has been posed,

> What are we to make of all this? Is this some sort of amazing coincidence, *or have isotopic dates always been ‘checked’ for ‘correctness,’ first directly against this sedimentation-rate based column, and then against earlier dates that had been checked against this column?* [emphasis in original] (Woodmorappe, 1999, p. 13).

Because of this similarity of modern and pre-radiometric time scales, it has been observed, “The basic time scale has remained unchanged since 1879, when the Ordovician period was inserted between the Cambrian and Silurian” (Rowland, 1983, p. 80).

The radiometric age for the earth is ultimately based on geological assessments of the age of the earth’s rocks, and the age of the earth’s rocks is ultimately based on extrapolations of a uniformitarian deposition rate for the (conceptual) geologic column. This rate in turn was derived from Charles Lyell’s arbitrary assessment of the age of the Cenozoic (Milton, 1997, pp. 19–23, 76–77). In Lyell’s time the earth’s age was thought to be of the order of 100 million years at most. Lyell put the end of the Cretaceous and the beginning of the Cenozoic at 80 million years ago, not so drastically different from the 65 million years assumed today.

Indeed, Speiker (1956, p. 1803) asked the rhetorical question, “I wonder how many of us realize that the time scale was frozen in essentially its present form by 1840,” that is, soon after Lyell had achieved prominence. The Cenozoic starts with the Tertiary, and the Cretaceous-Tertiary boundary is a significant demarcation in the fossil record, evidently connected with transition from Flood activity to the beginning of a post-Flood regime (Whitcomb and Morris, 1961, p. 283; Fritzsche, 1998, p. 247). However, the basis for Lyell’s chronology was not science, but rather a long-standing animus of the Word of God in general, and the chronology of Moses in particular. Lyell in fact altered data in an attempt to make his dating scheme appear reasonable (Taylor, 1987, pp. 82–83).

Lyell was by training a lawyer, or in the terminology of the time, a barrister, a fact formally acknowledged in the title of the memorial volumes published after his death (Lyell, 1881, vol. 1, p. iii; vol. 2, p iii). Lyell's real "hidden agenda" was revealed in private correspondence with colleagues and friends. He wrote that he had "driven" the biblical Flood "out of the Mosaic record" (Lyell, 1881, vol. 1, p. 253). He also revealed his plan for undermining the Bible. He would not make a frontal attack against the Scripture, but "conceived the idea … that if ever the Mosaic chronology could be set down [discredited] without giving offense, it would be in an historical sketch …" (Lyell, 1881, vol. 1, p. 271). Lyell's reference to "an historical sketch" meant a work about "historical geology" written from an evolutionary viewpoint. His well known *Principles of Geology* was the fulfillment of this plan.

In sum, Lyell using his legal skills would manufacture an opus presenting the alleged evolutionary version of the earth's geological past. He would lead his readers to doubt the chronology of Moses and the Bible as a whole without directly attacking it and without even naming it. With his *Principles of Geology*, published when he was only in his early thirties, he succeeded no doubt beyond his wildest dreams.

We are not left to wonder if Lyell was conscious of his indirect, deceitful maneuver against the Bible. He employed the same tactic generally, rarely asserting dogmatically what he wanted readers to believe, but cleverly allowing them to reach his conclusions on their own. Indeed, he wrote of his use of this tactic to encourage belief in biological evolution: "I left this rather to be inferred, not thinking it worthwhile to offend a certain class of persons by embodying in words what could only be a speculation" (Lyell, 1881, vol. 1, p. 467). Darwin observed Lyell using this tactic:

> Lyell is most firmly convinced that he has shaken the faith in the Deluge far more efficiently by never having said a word against the Bible than if he had acted otherwise. … I have read lately Morley's *Life of Voltaire* and he insists strongly that direct attacks on Christianity (even when written with the powerful force and vigour of Voltaire) produce little permanent effect; real good seems to follow only the slow and silent side attacks (Himmelfarb, 1968, p. 387).

Conclusions

"Time" in general, and the age of the earth in particular, is the heart of evolutionary theorizing. Even more, the conventional age of the earth is the ultimate foundation for other long chronologies, both inside and outside the solar system. The evolutionary age of the earth is ultimately based on nothing more than Lyellian uniformitarianism, radiometric claims notwithstanding, and Lyell's own agenda was to displace the biblical chronology with a secular one. Aside from the evidences that the cosmos does not have a long age, it is also true that discrediting an old age for the earth discredits old ages for the universe as well. Since the earth is not truly old, the billions-of-years chronology for the sun, the solar system, and the universe has no foundation. It is therefore no wonder that the humanist community has steadfastly rejected the concept of a recent creation for the earth. It is also clear that recent creationists must continue to defend the biblical doctrine of a young earth.

Along these lines, a group of creation scientists is currently looking at the theory and results of radioisotope dating. The preliminary conclusion is that substantial radioactive decay has indeed occurred in rocks. However, this decay has not taken place slowly over geologic ages. Instead, one or more episodes of accelerated decay with greatly shortened half-lives took place in the past, thus accounting for the array of radioisotopes allegedly requiring billions of years to form. According to Vardiman (2000, p. 4),

> It has been suggested that these increased decay rates may have been part of the rock-forming process on the early earth and/or one of the results of God's judgment upon man following the Creation, that is, the Curse or during the Flood.

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Notes from the Panorama of Science

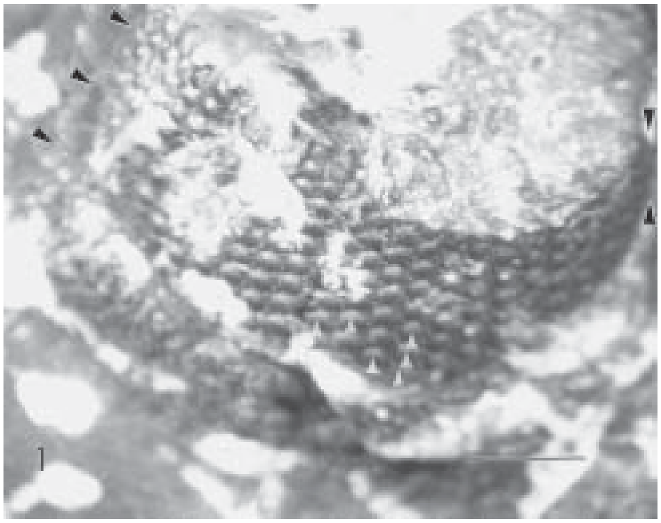

Figure 1. Light micrograph, unidentified trilobite specimen, approximately 2 inches in length, purchased from a "rock shop" in Holbrook, AZ. The lens assembly was chipped away from the body, mounted on a metal stub for imaging. Schizochroal lens assembly is shown (large bumps with white arrows). Lens assembly arc is 180+ ° (from left to right between black arrows). Scale bar = 400 microns.

Trilobites—The Eyes Have It!

It is well known that extinct arthropods known as trilobites occupy "ancient" (lower) sediments of the geologic column. The first trilobites appear in sediments dated by evolutionists at 520 million years ago—the upper part of the Lower Cambrian, and they extend well into the Permian (supposedly 200 million years ago).

Trilobites, like all arthropods, have paired, jointed appendages and a chitinous exoskeleton. The origin of arthropods in general, and trilobites in particular represents a problem for evolutionists, as mentioned by Osorio *et al*. (1997, p 244).

As Darwin noted in the *Origin of Species*, the abrupt emergence of arthropods in the fossil record during the Cambrian presents a problem for evolutionary biology. There are no obvious simpler or intermediate forms—either living or in the fossil record—that show convincingly how modern arthropods evolved from worm-like ancestors.

Additionally, trilobites represent some of the most sophisticated arthropods known to man. The trilobite eye, for example has been heralded as a structure far too complex to evolve over time by random variations in the genes

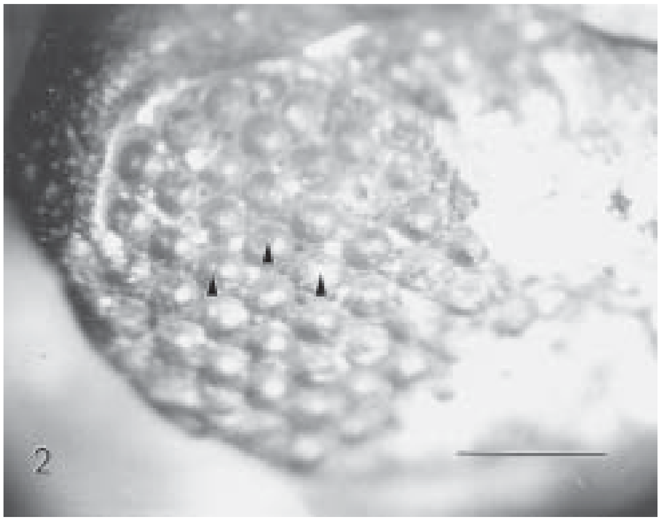

Figure 2. Light micrograph, schizochroal lens assembly. Individual lenses marked by black arrows. Scale bar = 300 microns.

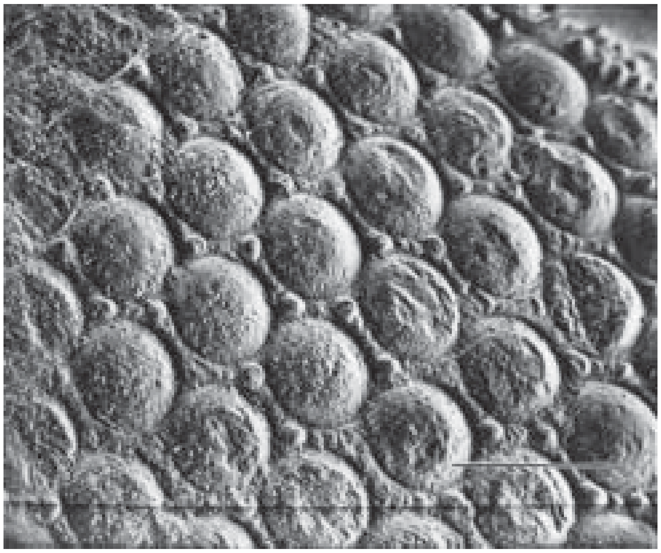

Figure 3. Scanning electron micrograph, unidentified trilobite specimen, schizochroal lens assembly. The specimen was coated with palladium on a scanning electron microscope (SEM) sputter coater for two minutes and viewed and photographed on a JEOL 35 SEM. Large bumps are individual lenses. Small bumps are unidentified, and their function is unknown. Scale bar = 150 microns.

of trilobite populations (Armstrong 1973 and 1976; Bergman 1992; DeYoung 2002; Wise 1989). Not only is the trilobite eye made of pure calcite (optically transparent calcium carbonate) which has a *precisely aligned* optical axis to eliminate any double image that would have formed (Armstrong 1973; DeYoung 2002), it is also a "doublet" of two lenses affixed together in order to eliminate spherical aberrations, commonly found in ground glass lenses (Armstrong 1976)! Trilobite eyes are massively arrayed in semicircular banks (See Figures 1–3) and even almost circular banks of up to 30-60 lenses per row, each with its own individual retina (McCormick and Fortey 1998; Gal *et al.* 2000).

Recent work on trilobite eyes has shown them to be even more complex than originally thought. Ordovician trilobites such as *Pricyclopyge binodosa* and *Jujuyaspis keideli* are said to have had a "large visual field" (Acenolaza *et al.* 2001, p 349) with "close to 360-degree vision" and "could see anteriorly, laterally, dorsally, and even downwards and backwards," from one position (McCormick and Fortey 1998, p 236). Further, it has been shown that another Ordovician trilobite, *Dalmanitina socialis*, actually has a doublet lens arrangement where the top calcite lens has a "conspicuous central bulge, the cause of *bifocality* [emphasis ours], which is a unique optical feature in the animal kingdom," (Gal *et al.* 2000, p 846). It is worth noting that only within the last 500 or so years, have scientists like Rene DesCartes, Christian Huygens and Ernst Abbe solved the difficult mathematical formulae which allow us to enjoy the optics we take for granted today. Yet trilobites, (which according to evolutionists went extinct 200-100 million years ago) manufactured these complex lenses right on their bodies.

Thus, evolutionists are faced with the vexing task of explaining the development of glasslike lenses that correct for spherical (and possibly chromatic) aberration, the density of seawater, and which also perform the function of bifocality (much like prescription glasses today), as a result of the chance assemblage of genes within populations of trilobites on the "ancient" seafloor.

To quote a well-known evolutionist and trilobite expert, "Trilobites had solved a very elegant physical problem and apparently knew about Fermat's principle, Abbe's sine law, Snell's laws of refraction and the optics of birefringent crystals…" (Levi-Setti, 1993, p 33). This, of course, is patently absurd, since arthropods know nothing of the laws of optics. It is thus clear that evolution cannot explain the presence of these astounding biological lenses.

Many paleontologists working with trilobites feel that evolutionism is a gradual process and that one can see trilobites changing from one form into another. This is countered by others, however who maintain that trilobites document the model of punctuated equilibrium, or periods of long stasis with no change followed by rapid bursts of innovation (Eldredge 1985; Eldredge and Gould 1972).

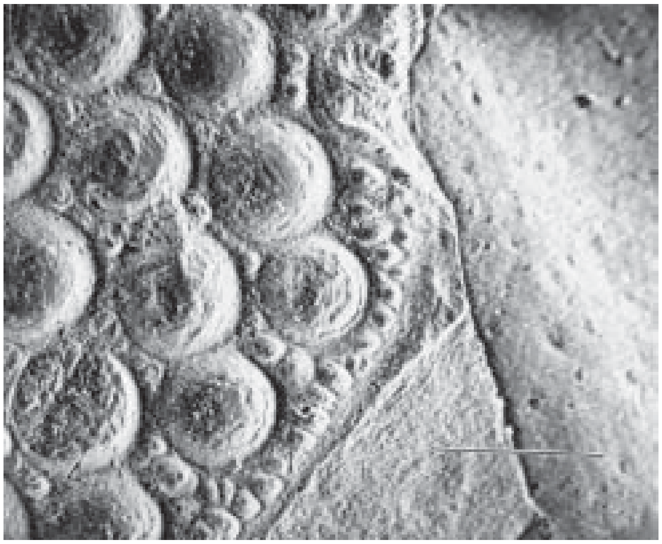

Figure 4. Scanning electron micrograph (SEM), unidentified trilobite specimen, schizochroal lens assembly. Scale bar = 120 microns.

Clarkson and others have sought the middle ground by their theories that many pulses of trilobite extinctions have occurred (Clarkson 1986; Palmer 1999) thus driving trilobites "back to the drawing board." Whatever evolutionary mechanisms are proposed for the development of trilobites, however, the field of trilobite classification is in disarray. One worker states, "[the field of] systematics [explaining biological diversity in an evolutionary context] is still in an unsatisfactory state…" (Fortey 2001, p 1151).

As microscopists, we do not frequent the lens "nursery" every year, hoping that new objectives have arisen from the endless procreation of "mother and father" lenses which live there. Instead, we patronize the lens factory, where intelligent designers are hard at work creating lenses that will help us gather more highly resolved images. As thinking entities, should we not acknowledge the Supreme Designer who built this capability into once living systems?

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"I have a great many questions about it [evolution]. I think that recent discoveries down through the years have pointed up great flaws in it."

—Ronald Reagan, quoted in *Science*, volume 209 (September 12, 1980)

The Exploitation of Non-Westerners for Evolutionary Evidence

Jerry Bergman*

Abstract

Africans and other non-Westerners were exploited in American and European sideshows for decades as evidence of Darwinism. These displays were a major attraction at many fairs and shows for over a century, and they probably helped to influence millions of people into accepting the idea of the evolution of humans from a lower primate. Although monetary gain was probably the primary motive, the promoters of these shows deceptively tried to pass off various non-Western peoples as "missing links," or at least as "primitive" humans who were evolutionarily less developed than Westerners. These displays had a significant influence on racial attitudes, and thus became important to movements such as the American Ku Klux Klan. Today, we see this history as a major example of the unethical exploitation of minorities.

Introduction

For decades, many fairs, amusement parks, and carnival attractions included displays of African, Asian, South American, or Australian natives that were billed and widely advertised as a scientific presentation of primitive or barbaric subhuman "men-monkeys," "ape men" and "ape women," or "missing links" (Bogdan, 1988, p. 177). These non-Westerners were typically "elaborately embellished" and wrapped "with a profusion of creative tales and twists" all packaged "within a pseudo anthropological framework" (Bogdan, 1988, p. 178). As a result, in the late 1800s to the early 1900s the general public was "fascinated by, or addicted to, the spectacle of primitive man" (Bradford and Blume, 1992). These attractions "popularized Darwinian notions of racial progress from 'savagery' to 'civilization'" (Rydell, 1999, p. 140). Historically, these popular shows were, at least for the masses, one of the more convincing evidences for Darwinism (Gordon, 1999; Parsons, 1999).

From the early 1800s until today, hundreds of millions of people the world over have visited fairs and circuses. Fairs were a leading form of entertainment for over a century, and even were popular for some time after the introduction of motion pictures (Durant, and Durant. 1957; Bradna and Spence, 1952). These fairs and circuses became a primary venue for these "wild man" exhibits. Consequently millions were exposed to these Darwinian propaganda shows during a period "sometimes called the Age of Darwin" (Lindfors, 1999a, p. vii).

These shows used Africans and other ethnic minorities who were made to appear to be convincing primitive men or ape-human links between humans and monkeys as Darwin's theory required (Lindfors, 1999b). Although the classic case is the display of a Pygmy named Ota Benga in a Bronx zoo, this practice had been going on for decades before this (Bradford and Blume, 1992; Bergman, 1993). One of the most famous circuses, Barnum and Bailey, regularly featured displays of humans that they claimed, or at least implied, proved Darwin's theory of human evolution or, more often, dishonestly led visitors to conclude they were valid evidence for Darwinism (Bergman, 2002). However, it is now well known that all of these claimed "Darwin's missing links" were normal humans from non-Western nations and cultures, usually Africans, but also some Asians, Australians, and South Sea islanders.

Many of the advertisements for these exhibits were specifically tailored to satisfy the public's curiosity about Darwin. One researcher concluded that Barnum was an expert in coming up with fake intermediate species, and "missing links were his specialty, and he kept his museum stocked with them, whether to fleshout the Great Chain of Being, or after 1859, when Darwin's *Origin of Species* appeared, to buttress the theory of evolution" (Blume, 1999, p. 190). The importance of these shows was noted by Kunhardt, et al. (1995) in their history of P.T. Barnum.

> … Barnum brought forth perhaps the most important spectacle of his entire career, a "Grand Ethnological Congress of Nations" made up of native "tribespersons" from all corners of the globe. He

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> had been planning such an assemblage since at least 1860 and possibly since 1851 … in the 1880s, he wanted to show forth "the uncivilized." "I desire … a collection, in pairs or otherwise," he had written in August 1882, "of all the uncivilized races in existence." … employing agents on every continent, eventually the project began to yield the longed-for "specimens"—Zulus and Polynesians, Nubians and Hindus, Todas Indians and Afghans, Australian aborigines and Sioux Indians and Laplanders. …Nothing of its kind had ever been seen before in America or elsewhere. …Public fascination with Barnum's "Congress" was intense; mostly white audiences howled with laughter at the "inferior" beings on display. The Chicago *Tribune* summed up Americans' attitudes by describing the Australian aborigines' "almost jet black skin" and "gorillaish features." (p. 296).

Many "scientific" displays also tended to add to the problem. For example, displays of "native villages" at the 1893 Columbian Exposition in Chicago inspired circuses to enlarge their own displays of tribal people (Bogdan, 1988, p. 185). The anthropology displays of "primitive" humans at the 1917 World's Fair received fully 40% of all press notices (a further indication of the popularity of such exhibits). This particular fair, as did many, "displayed" a group of Pygmies, and "the historical record shows that Pygmies had been heavily in demand since time immemorial" (Bradford and Blume, 1992, p. 18). Apparently, the "animality" of Africans was one trait thought to set them "apart from more rational varieties of the human species" (Lindfors, p. viii). For years it was believed, even by some "experts," that "the Pygmian race was a race of apes" (Bradford and Blume, 1992, p. 20). The Pygmies "seemed scarcely human … not more intelligent than the trained baboon on a bicycle" (Green, 1999, p. 172) and "were the subject of ethnological inquiry and debate by scientists in learned societies" (Bogdan, 1988, p. 188). Many of these primitive people, the showman claimed, had no recognized language, no marriage state, and lived like animals.

People flocked to see such "ape men" at these shows. Green (1999) estimated in one week "well over ten thousand Britons were entertained by the Congo Pygmies" (p. 174). Only following Turnbull's work, in the 1950s, were the Pygmies, as a people, more accurately understood and the conclusion that they were "ape-humans" was finally and fully discredited (Turnbull, 1968).

Likewise, many other races also were considered less evolved than whites, serving as living "links" to human evolutionary past. Other persons from Africa (such as from the Zulu tribe) were marketed as "apelike creatures" and "bestial Africans" (Bogdan, 1988, p. 187). The Hottentots were also commonly displayed, often billed as "examples of the most primitive people in the world" (Bogdan, 1988, p. 187). Advertisements of the day frequently claimed that, from an evolutionary viewpoint, the Africans were as near to the ape as they were to humans. Often, they would not openly claim that Negroes were a missing link, but rather use expressions similar to "we cannot help but wonder if" the Africans were not "Darwin's missing link" (Bogdan, 1988, p. 192). Only with the eventual discrediting of the eugenic idea of human racial inferiority (as well as the whole eugenic movement), were such races no longer viewed as evolutionarily inferior.

The Influence of Darwin

Darwin's writings were critical in popularizing the view that humans evolved from some apelike ancestors. His work was also a critically important impetus to the exploitation of non-Westerners in freak shows. For example, Darwin's writings directly supported the conclusion "that some forms of humans were closer to their primitive ancestors than others" (Bogdan, 1988, p. 249). Darwin devoted a whole chapter in his book, *Journal of Researchers* (Darwin, 1939), to the "primitive" people who lived on this territory. He claimed they were so primitive that "when pressed in winter by hunger, they kill and devour their old women before the people kill their dogs" (p. 214).

Soon after evolution became widely discussed (and later widely accepted) due to the work of Darwin, both the frequency and diversity of "exotic people" shows grew steadily (Rothfels, 1996, p. 164). Under the subheading *"The Search for Man's Ancestors*," Smith, et al. (1931) noted that after Darwin "the interest of anthropologists and of the intelligent lay public has been keenly alive to the possibility of finding, dead or alive, other links in man's ancestry" (p. 20). It was through these displays that people could see humans who, so it was claimed, were similar to how humans looked not long after they had "left the ape behind" (Rothfels, 1996, p. 164). Ape-looking tribes had been used as evidence of evolution before Darwin published his classic work *The Origin of Species*, but many people, at least until the middle of the nineteenth century, believed that African inferiority was due to environment (Erlmann, 1999, p. 112; Fiedler, 1978, p. 240). Certain ethnic groups especially were exploited prior to Darwin's time, but the problem became far worse after evolution was popularized by scientists (such as Erasmus Darwin in the early 1800s) and writers (such as Robert Chambers).

Although it was widely known in pre-Darwin times that many humans lived in primitive conditions or an uncivilized state, they still were considered noble beings created by a loving God (Snigurowicz, 1999). When Darwinism was embraced by the masses, all this changed. Once it was accepted that humans evolved from lower primates, these savages were no longer viewed as people living in primitive conditions, but biologically primitive creatures that were less evolved than Westerners. Certain races (such as the Hottentots) were widely believed to be the "missing link" between humans and animals (Strother, 1999, p. 10). When humans became "only transformed monkeys," as a result of Darwinism, finding people groups who were still transforming and evolving was expected (Snigurowicz, 1999). Some Darwinists even claimed that "Negroes were a result of cross breeding between humans and Simians" (Fielder, 1978, p. 240). The impetus behind the display of non-Westerners in fairs was once explained as follows:

> With such sensational discoveries as the Neanderthal Man—one of the most important freaks of all time—in a cave outside Düsseldorf in 1856, and even more importantly, the publication in 1859 of Charles Darwin's *Origin of Species*, which was eagerly received by German scientists, the idea of evolution gained a scientific and popular currency in Germany that contrasts with reactions in other Western countries. Broad sectors of the public and scientific community became fascinated with what the theory of natural selection suggested about the development of man from non-humanoid species, as well as with what it implied about the origins of races and cultures. Recalling the acceleration of interest in evolutionary theory in Germany, anthropologist Carl Stratz noted in 1904 that "the various more primitive human races were examined for their resemblance to apes … a list of pithecoid (ape-like) characteristics of man was compiled, and the missing link—the last connecting link between human and ape—was sought after with enthusiasm" (Rothfels, 1996, p. 162).

Trained to Act Like Darwin's Missing Link

The men and women selected for these displays not only *looked* the part, but also were often trained to *act* the part as well. For example, they were told how to act, and often were given props such as sticks to hold, implying that they did not normally walk on two legs, but rather locomoted like a monkey. Some were dressed in only loincloths, and were taught "jungle language"—mostly hideous grunts—to help them act out their Darwinian ape-man charade. Many were good actors, and convinced millions to believe that they were in fact "ape-men" (Cook, 1996). Although most were non-whites of normal intelligence, they learned how to act stupid and primitive (and had to be good actors to draw the crowds needed to make money). Common distortions of their culture included claims that they were cannibals who practiced polygamy, head hunting, or human sacrifices, and ate rodents, insects, and dirt. Other "lies and extravagant, overstated claims" were common (Bogdan, 1988, p. 107). These "phony Zulus" were "easy to hire, cheap, and cooperative" (Bogdan, 1988, p. 176). Not unexpectedly, after the widespread acceptance of Darwinism, a rapid rise of exploitation of foreign races occurred:

> Darwin's evolutionary theorizing gave impetus to ever more fantastic speculation about the nature of the intermediary between "man" and monkey in the French social imaginary. Exhibits such as *hommes-* and *femmes-singes* (monkey-men and -women) and various other types of "primitive" intermediaries and *savages* proliferated in fairs and carnivals and other venues of popular entertainment, such as music halls and cafés-concerts. Press reports and articles, and dramatic and literary works satirized, lampooned, and otherwise conjectured about a possible intermediary between "man" and monkey (Snigurowicz, 1999, p. 57).

The "Aztec Children" and other displays in the early 1850s preceded the great surge of excitement in evolution, but Darwinism soon became a major component in the enfreakment of a wide range of individuals (Rothfels, 1996, p. 162). An example Rothfels (1996) mentions is the "Terra del Fuego" people, which Darwin discussed in his writings:

> The 1881 "Terra del Fuego" exhibit presents a classic case. …the "Fuegians" simply sat quietly, walked around the grounds, and prepared their food on an open fire without the use of pots. The public, despite the apparent mundaneness of these activities, was staggeringly enthusiastic. In Paris more than 50,000 people visited the show on one Sunday, and at the Berlin Zoological Gardens, "in order to avert the earlier wild scenes of the rush of the public, a large stage some four feet in height had to be erected upon which the Fuegians were situated." Most of the public was clearly more than satisfied with simply gazing upon these apparently "primitive people" (p. 164).

Some Americans—who were fakes posing as African natives in the exhibits—later were "exposed for the 'civilized' humans that they were" (Snigurowicz, 1999, p. 59; see also Killingray and Henderson, 1999). Lindfors claims "many" of the Zulu "performers" at one time were frauds (1983, p. 11). These "fake savages," though, were, just as fake as the real savages pretending to be Darwinian "ape-men" links. Bogdan (1988) cited several cases of native-born Americans who were misrepresented as foreigners, such as Ohio-raised dwarfs who claimed to be from Borneo; a tall, black, North Carolinian who, it was claimed, was from Dahomey, and "African natives" who actually were Blacks recruited from Chicago pool halls. Another example is, when in front of the public, the Aztec's bushy hair always was tied up on topknots to emphasize their small heads, and they often were photographed in profile to display their "ape-like sloping foreheads" and noses (Snigurowicz, 1999, p. 58). The people in many exhibits wore leopard-skin shorts or similar attire to look more primitive and more animal-like (Peacock, 1999). The make-up department did such a good job that some Africans "seemed scarcely human at all" (Green, 1999, p. 172).

The Belgian Congo Ape-Like Ubangis

A notable example of the exploitation of Africans was the Ubangis tribe. The Ubangis were a group of women imported from the Belgian Congo to play the role of Darwin's missing link in Barnum's circus. To emphasize their putative primitive human attributes, Ubangis often were displayed almost nude, often with monkeys and sounds of drums in the background (Bogdan, 1988, p. 195). The Ubangi show advertisements claimed that they lived "like animals" and "smelled like hogs." When tossed bananas "as though they were so many chimpanzees," they ate the bananas "like apes" (Bradna, 1952, p. 245). They were "easy to feed"—their diet consisted of only two meals a day, "bananas with skins, peeled oranges, and raw fish" (Bradna and Spence, 1952, p. 245). Bradna and Spence (1952) also report that the "Ubangis had a hypnotic fascination, and the public could not get enough of them. Men and women gaped at them for five minutes steadily in the sideshow, then returned at the next performance for another look" (p. 246). The Ubangis ape-women were claimed to have drawn a greater crowd than any sideshow the circus ever presented (Bradna and Spence, 1952, p. 318). The Ubangis were displayed until at least 1932 (Lindfors, 1983). The popularity of such shows was so great that:

> By the nineteenth century, most cities of Europe had hosted regular exhibits of "strange" peoples, including the almost traditional appearances of Sub-Saharan Africans, Moors, Sami, and other Old World peoples, as well as such new arrivals as Native Americans, Inuit peoples, and South Sea Islanders. In the second half of the nineteenth century, both the frequency and diversity of the shows of "exotic" peoples grew steadily. … [and] among the most consistently popular exhibitions in the latter half of the century in Germany were those that focused on "primitive" peoples, who could, like "Krao," somehow be freaked as evolutionary ancestors of modern Europeans (Rothfels, 1996, p. 164).

The Influence of Ape-Men Exhibits on the Common People

An important myth derived from Darwinism was the belief that creatures intermediate between humanoids and anthropoids must exist. Related to this idea is that of devolution, i.e., that our children or our children's children may revert to the subhuman creatures that we once were in the distant past (Fiedler, 1978, p. 241).

In the words of Odell (1931), "the world was gradually preparing for Darwin and checking him up in terms of Barnum" (p. 413). These ape-human exhibits were no doubt both highly impressive and very convincing to the large, naive, and often uneducated audiences who regularly viewed them. Otherwise, why would millions flock to see the shows for a price that was not cheap in their day? It is not known how many hundreds of millions of people visited these "ape-human" exhibits, and as a result became convinced of the truth of Darwinism. It *is* known that the shows "made a lasting impression" on a large number of people (Bondeson, 1997, p. 217).

These exhibits were not only blatantly dehumanizing, but dishonest. The exhibitors in virtually all cases deceptively pawned off their exhibits to the public either as proof of Darwin's theory of evolution, or occasionally as evolutionary throwbacks called atavisms. That most of these ape-humans were normal humans was well recognized even in the 1800s (Gould and Pyle, 1896). The circuses and exhibitors usually were not motivated primarily to prove evolution and, indeed, in many (if not most) cases, they knew that their exhibits were fully humans. The primary motive in most cases was largely financial, resulting in a "big business" that enabled many people to become rich (Bogdan, 1988, p. 198). Nonetheless, the end effect was to help convince the common people of the truth of Darwinism, which was one more factor that was influential in causing the rapid conversion of large segments of the population to belief in Darwinian evolution.

Common Objections to the Exhibits

One of the most common objections to the exhibits was the concern, especially by the clergy, that they could cause people to question the divine origin of life. Specific objections included the belief that they could cause some of the public to doubt that "life was the result of the Creator's 'divine spark,' and, moreover, that human life was endowed with special God-given qualities such as reason, creativity, and speech" (Snigurowicz, 1999, p. 62).

Of course, this objection was fully valid since these shows probably helped to convince large numbers of people of the validity of Darwinism, as well as to accept (or reinforce) racism. These freak shows were "accompanied by the rise of the eugenics movement, a vicious use of social Darwinism which cautioned the nation that because modern societies protected their weak, the principle of survival of the fittest was not working" (Bogdan, 1988, p. 62).

Many people also objected to these shows because the exhibits often were misleading, and deliberately tried to give the impression that those individuals on display were less than human and were to be observed like animals in a zoo. Many persons recognized that the shows contributed not only to racism, but also to acts of violence as well, especially against blacks (United Nations High Commissioner for Human Rights, 2001).

Most Scientists Were Silent

In general, scientists "limited their commentary to specific exhibits, describing them and reflecting on their scientific importance" (Bogdan, 1988, p. 64). Some scientists recognized that many of the shows were, at best, misleading. Although Darwin concluded that the Feugians were "the lowest of human forms yet discovered," other scientists, such as German anthropologist Rudolf Virchow, recognized that this ethnic group did *not* represent "some form of transitional stage between ape and man" (Rothfels, 1996, p. 165). The latter view did not tend to help the "ape-man" business, nor did it support Darwinism, and so was ignored as much as possible. The "popular perception … a perception rooted in the way the 'savages' were displayed and enfreaked—tended to focus on the deep differences between them and Europeans" (Rothfels, 1996, p. 165). Consequently, the views of scientists like Virchow usually were silent (or silenced). Carlyon (2001), in a history about showman Dan Rice, said that the "racism of the day included confused racial categories, with the 'darkey' neither white, black, nor colored," and museums of the day did little to help clarify the confusion.

> An important element of the Museum was the lecture room, which made the claim of education manifest….Though the jumble of attractions at the Museum seems unscientific, it was not frivolous. Louis Agassiz, the famous naturalist and Harvard professor, came to New Orleans the same season for the same reasons as Rice's Dr. Koch, to lecture on natural history to inquisitive citizens. The Wild Men of Borneo may have been slaves, as many such exhibited "natives" were, and the Zeugladon might have been a fake, but, as people turned their gaze to the Pacific seas or into prehistory, the ground was being prepared for the work of anthropologists, and for the ideas of Darwin (Carlyon, 2001, p. 154–155).

The problem of exploitation of non-Westerners was also usually ignored in the academic press, and the "ape-men" shows were rarely or never criticized or exposed for the harm they caused. All too often, non-Westerners were exploited by Darwinists in an attempt to document their case, even into the 1960s (for example, see Coon, 1962). Steinitz even quoted Darwin's words from his *Journal of Researches* (Darwin, 1839) that the "Fuegians hardly seem to be fellow creatures and inhabitants of the same world" as we Westerners are. Rather, they "were crude, wretched creatures" that "smeared their ugly faces with paint" (quoted in Rothfels, 1996, p. 165). No doubt Darwin's writings and those of other persons with similar ideas (such as his cousin Francis Galton) contributed to the later "genocide launched from the barrel of a gun" when the "Fuegians were mercilessly hunted down by European settlers" (Hazlewood, 2000 p. 12, and illustration facing p. 273). Hazlewood (2000) adds that the story of Tierra del Fuego has been told many times by many writers including Darwin, but in all of these stories the:

> Fuegians are absent, save as freaks and novelties or nuisances and obstacles to the advance of the white man and his civilization. To most of the Europeans and North Americans who ventured into these parts, they were a primitive and wretched group of savages, lawless atheists who lived in squalor—as Darwin was to say, they were "the most abject and miserable creatures I anywhere beheld"—and thus undeserving of a history. Eventually, when they began to be heard, as in the accounts of the Ushuaia mission station, established in the 1870s, it was both too late. …Most tragically, by the time historians, anthropologists, archaeologists and ethnographers with a different, more sympathetic approach to the native population arrived on the scene, there was virtually no one left to study. Wiped out in a genocide launched from the barrel of a gun and the spread of alien diseases, much of the history of the Fuegian peoples died with them (p. 12).

Darwin's (and his followers') eugenic ideas were included in major textbooks as late as 1962 (Coon, 1962). The civil rights movement had a major impact in ending the exploitation of non-white races, especially those from Africa. Such displays would be unthinkable in the Western world today. However, this new enlightenment cannot change the fact that for decades "evolutionary theory propelled the search for individuals such as 'Krao,' and even whole peoples such as the 'Fuegians,' who could somehow be construed as representing links in human evolution" (Rothfels, 1996, p. 165). Interestingly, Darwin at first judged the Fuegians as primitive humans, but later changed his view of them after he recognized the changes in their lives that occurred after they converted to Christianity. As a result of this experience, Charles Darwin personally contributed to the mission society working in Terra del Fuego (Hazlewood, 2000).

Human-Animals Claimed to be Darwin's Missing Links

Some exhibits presented creatures that were allegedly a result of "crossbreeding between man with beast [which] … also implied a biological link" (Bogdan, 1988, p. 106). Another popular explanation was that the humans on display were atavistic or evolutionary throwbacks to earlier evolutionary stages of humans (Bogdan, 1988). Animals, especially trained primates including apes, chimps, and orangutans, also were touted by many circuses and shows as "missing links" between animals and humans. For example, in the 1840s, Barnum displayed—in a wildly popular exhibit—normal orangutan as "the connecting link between man and brute" (Saxon, 1989, p. 98). Kunhardt, et al. (1995) relate the story of one primate that became a famous "missing link."

In 1846, Barnum purchased, for $3,000, "the only living orang-outang in either England or North America." Calling her Mademoiselle Fanny, after the great ballerina Fanny Elssler, Barnum promoted the animal as a possible missing link. "Its actions, the sound of its voice while laughing and crying, approach as closely as possible to the human species," one paper reported. "Its hands, face and feet are pure white, and possess as soft a skin as any child living" (1995, p. 110).

Summary

For decades, charlatans have exploited non-Westerners as "missing links" for profit and entertainment. The promoters of these shows not uncommonly, and quite deceptively, passed off various non-Western peoples as missing links, or at least as primitive and less developed, compared to Westerners. Africans and other non-Westerners were exploited in sideshows for over a century as evidence of Darwinism. These displays were a major attraction of many fairs and shows, and they likely influenced millions of persons to accept the theory of human evolution from the lower primates. The contribution of these displays to racism and racist movements also was significant. Many of these non-Westerners "lived miserable lives," were exploited, and, in general, poorly treated. But this "did not seem to concern pre-1940s American audiences or the exhibitors—after all, the people being exhibited really were cannibals, savages, and barbarians" (Bogdan, 1988, pp. 198–199).

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Grand Falls, Arizona: Evidence of Missing Uniformitarian Time

Carl R. Froede, Jr. and Emmett L. Williams*

Abstract

Grand Falls, Arizona, presents a beautiful setting in which to investigate the uniformitarian interpretations of near-consistent processes occurring over millions of years of time. The Little Colorado River, which incises the Kaibab and Moenkopi formations, was diverted from its course by a basaltic lava flow from the Merriam Crater, forming the falls. We examined the geomorphologic and stratigraphic setting, and postulate an historical model. Evidence in support of uniformitarian time was not found. Rather, it appears that a subaerial eruption of lava flowed across the top of the Kaibab and Moenkopi strata within the last few thousand years. The Kaibab carbonates and overlying Moenkopi sandstones reflect Flood deposition, while the basaltic lava flow was emplaced later, during the post-Flood Ice Age Timeframe. The geomorphic and stratigraphic setting of Grand Falls is consistent with the short time frames predicted by the young-Earth Flood framework.

Introduction

Grand Falls is approximately 30 miles northeast of Flagstaff, Arizona (Figure 1). It formed as a result of a lava flow that originated from Merriam Crater (Figure 2). The lava erupted and flowed approximately 7.5 miles to the northeast and dammed a section of the Little Colorado River. It is probable that the lava flow occurred rapidly as there is evidence that it flowed not only into the former river channel, but also for some distance along its course.

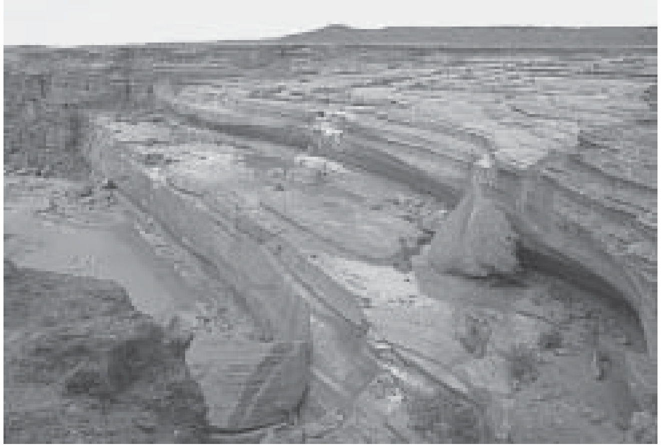

Figure 1. Grand Falls remains dry for most of the year, except during spring snowmelts from the nearby San Francisco Peaks or the occasional summer thunderstorm (Nations and Stump, 1996). The difference in elevation from the top to the base of the Falls is approximately 160 feet. It is more than twice that distance in width.

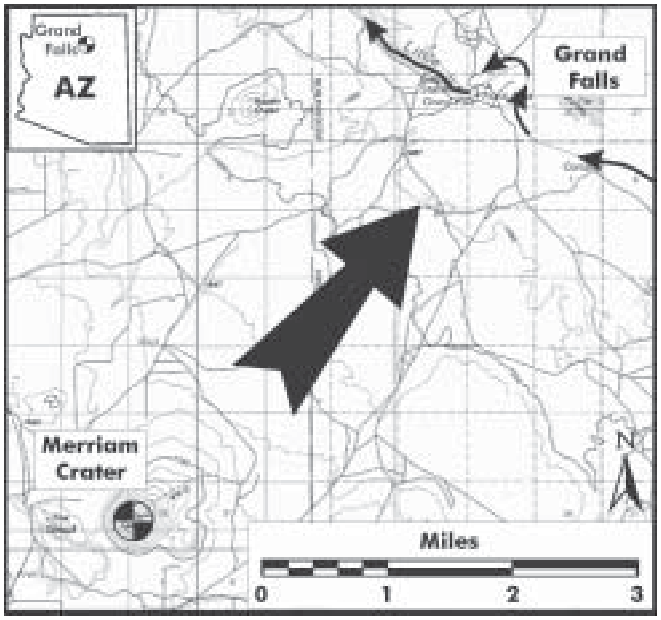

Figure 2. Topographic map showing the relationship between Merriam Crater and the lava flow that blocked the Little Colorado River creating Grand Falls. Modified United States Geological Survey Flagstaff, Arizona Topographic Quadrangle.

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The river has subsequently diverted around the front of the basalt flow and has returned into its original channel (Figure 3).

This location provides an excellent setting in which to test various uniformitarian assumptions. Evidence should be readily apparent supporting the purported 250 million years (Ma) of time having elapsed between the paleo-land surface and the subsequent overlying lava flow. Additionally, there should be evidence highlighting the differences in the erosional history of the river, along with the effects that weathering had on the basaltic lava flow. Hence, there should be ample evidence surrounding Grand Falls in support of the uniformitarian model of Earth history.

Grand Falls

Grand Falls has been studied by various geoscientists who have interpreted the geologic setting within the uniformitarian framework (Colton, 1967; Rigby, 1977; Wolfe, 1984; Nations and Stump, 1996; Gordon, 2000). Uniformitarian geologists age-date the Kaibab Formation to the Late Permian Period (250 to 260 Ma) [Gordon, 2000], and the Moenkopi Formation to the lower Triassic Period (235 to 245 Ma). At Grand Falls, the Kaibab limestone is believed to be unconformably overlain by the Moenkopi Formation sandstone or the basaltic lava flow where the sandstone is eroded away (Figure 4). For the area immediately

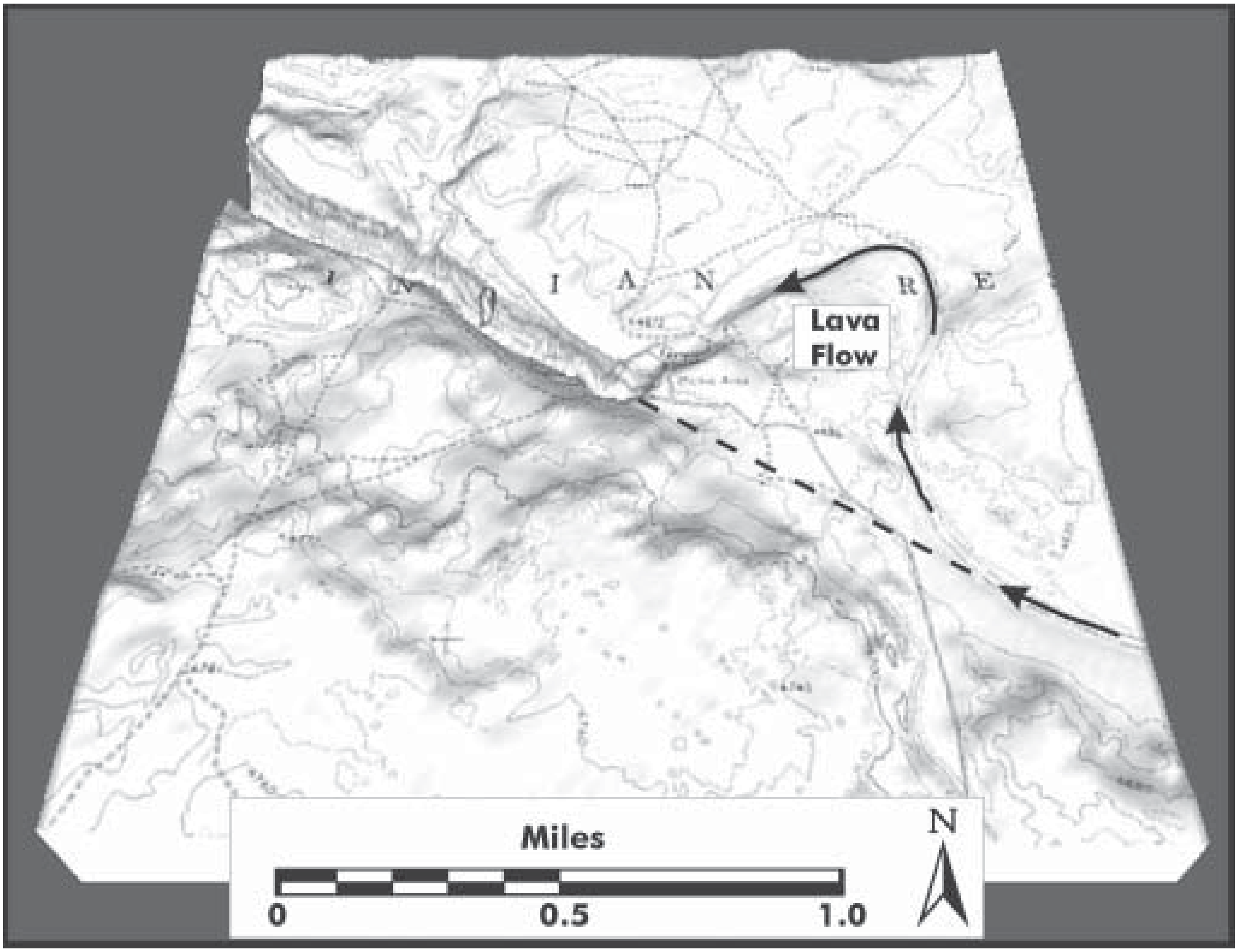

Figure 3. Topographic map showing the area immediate to Grand Falls. Arrows indicate the present course of the Little Colorado River and the dotted line represents the former channel. Note the drastic change in the depth of the river channel when the strata change from Moenkopi sandstone to Kaibab limestone. The limestone weathers more rapidly. Modified United States Geological Survey Quadrangle using Maptech ©2001 software at 4X elevation.

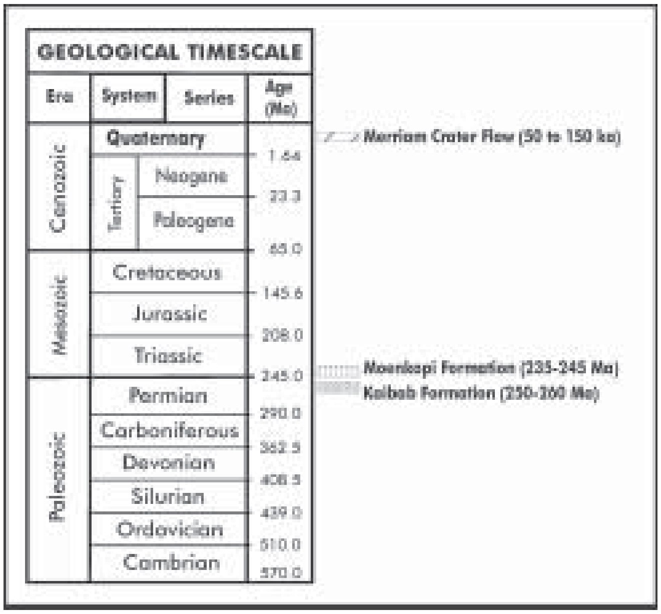

Figure 4. Generalized geologic timescale showing the chronostratigraphic position of the stratigraphic layers found exposed at Grand Falls. The gap between the Kaibab/Moenkopi and the overlying Merriam basalt is missing from the rock record. Are rocks missing because of erosion or were they never deposited? Either way, the existing strata should present evidence showing the passage of millions of years of time if that much time has actually elapsed.

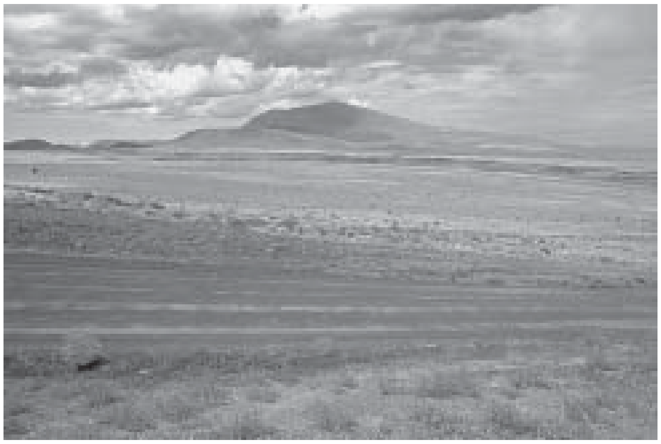

Figure 5. Merriam Crater is the taller of the two exposed craters and rises majestically above the plain. The lava flow that emanated from its base moved toward the right side of the photograph, down to the Little Colorado River.

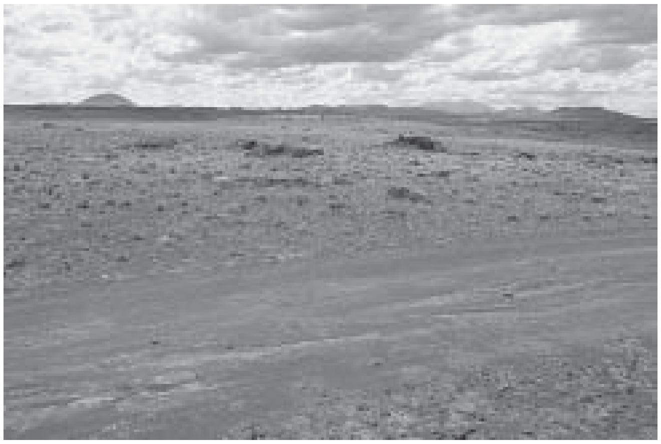

Figure 6. Looking across the Merriam lava field, near Grand Falls. Note the numerous pressure ridges exposed across the surface. There is much detail found around these ridges. The rather low relief reflects pahoehoe lava flow. The surface is eroded and covered in places with plants. This is not what would be expected if 50 to 150 thousand years of weathering had occurred.

adjacent to Grand Falls, we can assume that the top of the Kaibab Formation where the Moenkopi Formation is missing, should age-date to around 250 Ma.

Volcanic History

The Merriam volcano (Figures 5 and 6), located on the eastern side of the San Francisco volcanic field, is believed to have erupted at a late stage in the area's history (Colton, 1937; Luedke and Smith, 1991; Patton et al., 1991; Warner, 1978). The northeastward direction of volcanism associated with the San Francisco volcanic field is believed to be the result of major fracture zones in the lithosphere (Tanaka et al., 1986), also identified as the Colorado Lineament (Warner, 1978). Large-scale volcanic eruptions have occurred within this area and over 350 vents have been identified throughout the San Francisco Volcanic Field (Colton, 1967).

Age-dating the Merriam lava flow has been a priority in understanding the eruptive history of the area. Because of the relatively unweathered condition of the lava and the well-defined structure of its flow, Colton (1967) proposed a recent age for this basalt lava flow. Age-dating of the associated caliche supported his interpretation with an approximate age-date of 5,600 years (Colton, 1967, p. 53).

However, more recent age-dating by uniformitarians has increased the age of the Merriam lava significantly. Wolfe (1984) stated that the Merriam-age flows range in age from approximately 50 to 150 thousand years. Therefore, we can assume that Grand Falls age-dates to this same period as it formed as a result of the Merriam lava flow.

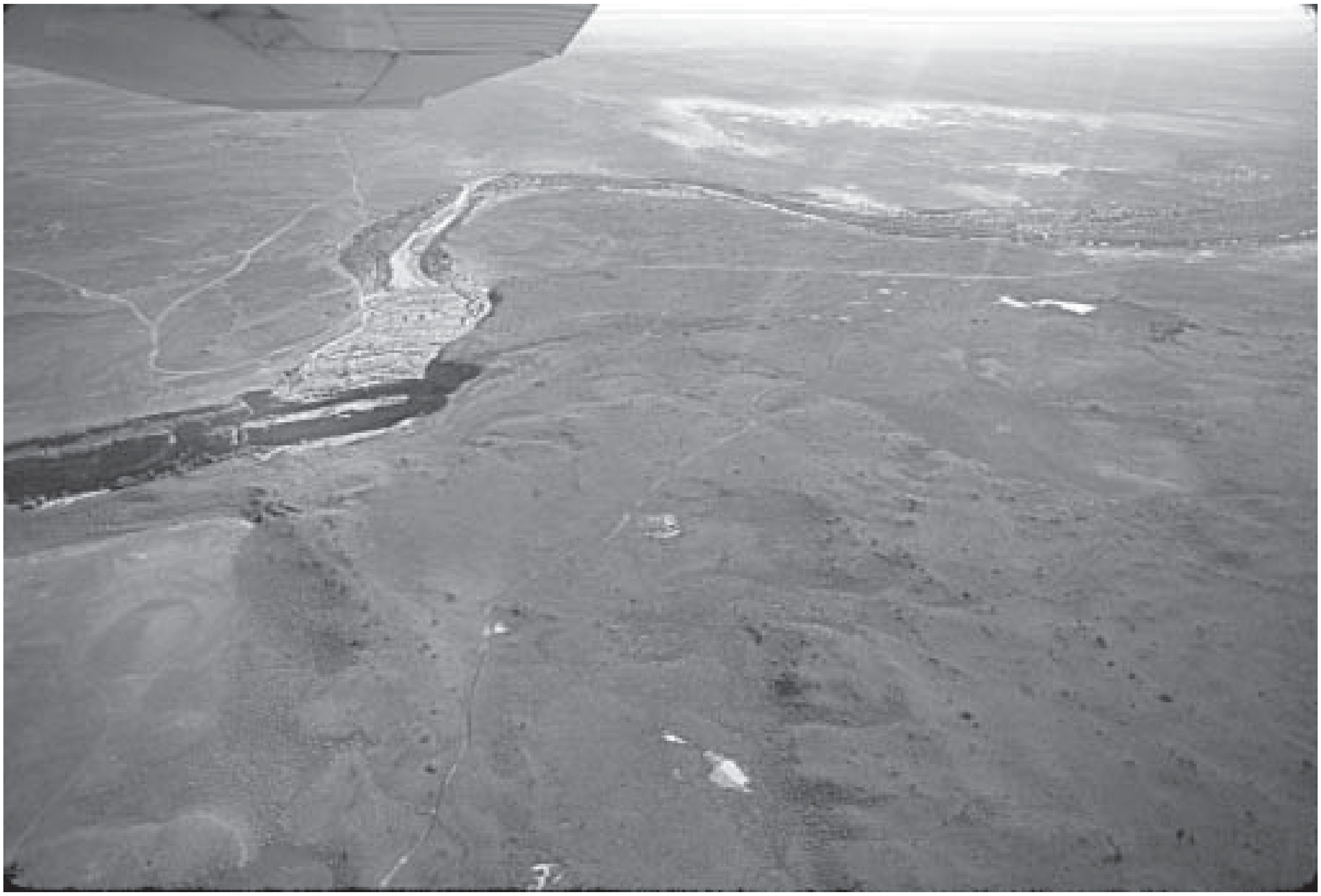

Figure 7. Aerial photograph that reveals the significant differences between the Little Colorado River flowing across the Moenkopi sandstones (right side of image) and the Kaibab limestones (left side of image). Note how the river has created a deep and narrow canyon in the Kaibab carbonates. This is opposite to what is expected in uniformitarian reasoning.

Uniformitarian Erosional Rates Oppose Observational Data

Within the area of Grand Falls, the Little Colorado River flows across the top of the Moenkopi sandstone (upgradient to the falls) and then across the top of the Kaibab limestone (where the lava flow blocks the former channel). According to Colton (1937; 1967), the Moenkopi sandstone erodes "much faster" than the Kaibab limestone. However, just the opposite is demonstrated along the course of the Little Colorado River. In fact, the Kaibab limestone has experienced tremendous erosion along its channel once the river descends from Grand Falls (Figure 7). Based on the channel erosion experienced by the Kaibab limestone downgradient from Grand Falls, we should expect to see a highly eroded Kaibab limestone surface in adjacent areas if it experienced approximately 250 Ma of erosion.

Weathering of the Merriam Basaltic Lava Flow

Colton's (1937; 1967) work classifying the age of the various vents and volcanic features found across the San Francisco volcanic field centered on weathering effects of both the eruptive vents and their associated lava flows (Figures 8 and 9). He considered the Merriam Crater and lava flow to be Stage IV:

> Stage IV. The true edge of the flow is visible. The surface is rough and broken. Lava tops are present but displaced by frost. Spatter cones and pressure ridges are prominent features.

Regarding the condition of the Merriam basalt flow, Wolfe (1984) stated:

> ...the surfaces of Merriam-age flows are rough and relatively fresh. The flows commonly have promi-

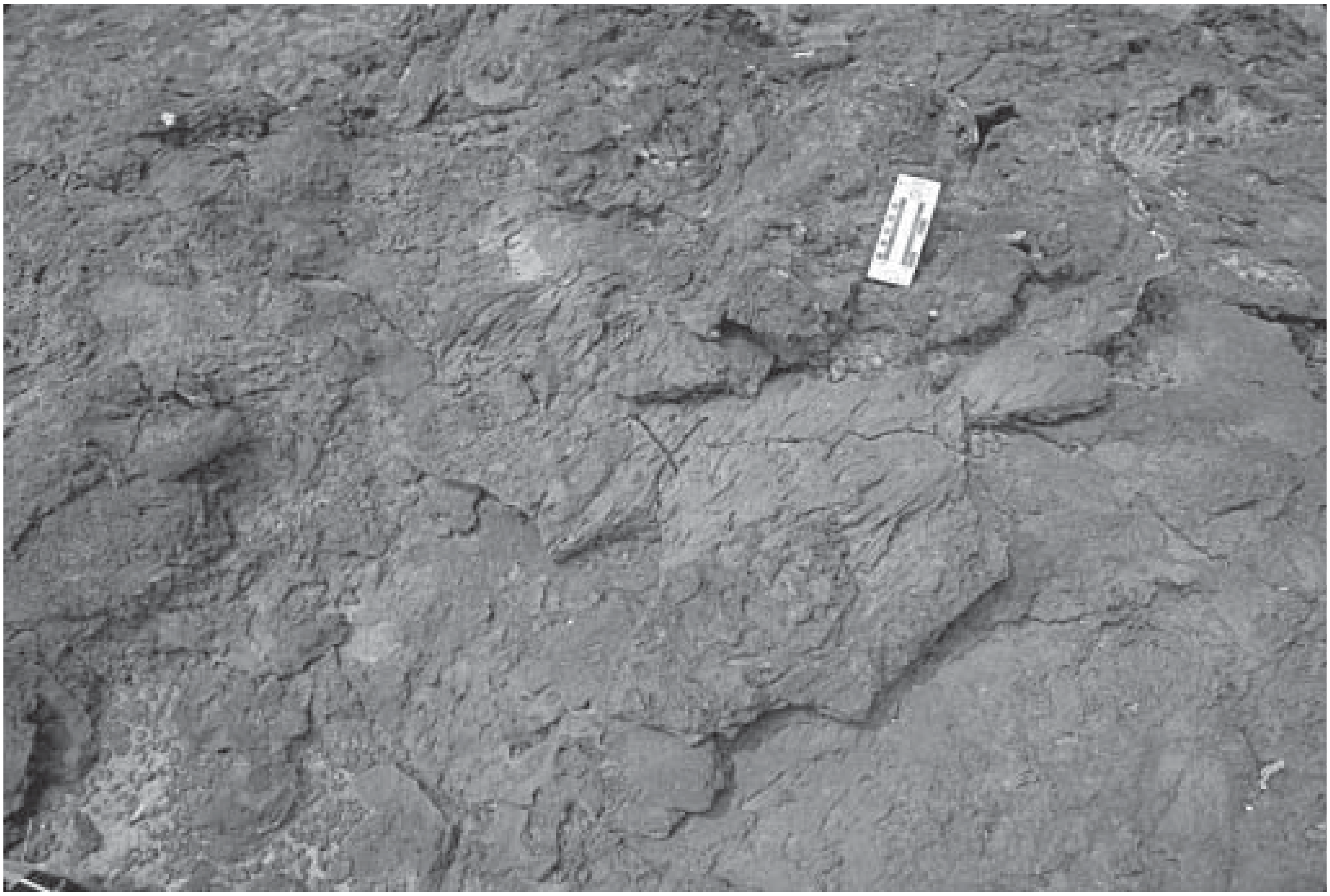

Figure 8. Agglutinated lava flow with excellent preservation of the flow features. The presence of these delicate features argues against the proposed uniformitarian age-dates ranging from 50 to 150 thousand years. Scale in inches and centimeters.

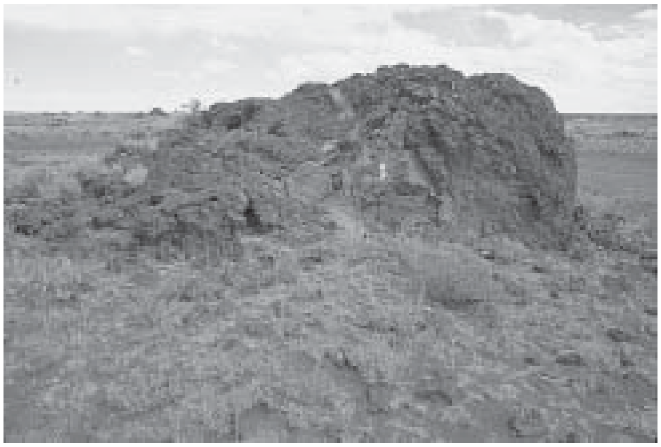

Figure 9. Large pressure ridge. This feature rises several feet above the lava surface. Exposed within it are many delicate features that are frozen in rock. This is not expected if vast amounts of time passed since its original emplacement. Weathering should have broken the rock down into sand and clay.

> nent ridges at their lateral margins, and delicate flow structures.

Moore and Wolfe (1974) described the "Merriam age-group" volcanics as:

> Basalt flows of the Merriam age-group are generally rough and relatively fresh, commonly with well developed levees and with delicate structures preserved on the flow tops.

In later work, Moore and Wolfe (1976) described the Merriam basaltic lava flow surfaces as rough, relatively fresh pahoehoe and aa forms of lava.

According to uniformitarian geoscientists, this region experienced three major periods of alpine glaciation during the Pleistocene (Updike, 1969; 1977; Péwé, Merrill, and Updike, 1984). Based on the age-date range of the Merriam basaltic lava flow, it could possibly extend through at least two of those glacial periods. While alpine glaciation occurred only in association with the San Francisco Mountains, it does reflect a wetter climate than what the region experiences at present. Because of increased fluvial

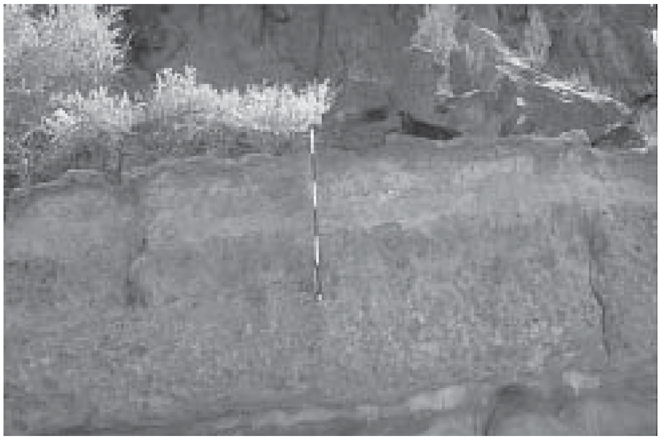

Figure 10. Contact between the Merriam basalt and the underlying Kaibab limestone. A melt zone exists just below the contact within the limestone. Beneath this surface we should expect to find evidence for 250 million years of erosion. Instead, we find massive limestone with no indication of earlier weathering. Where is the evidence in support of uniformitarian time? This outcrop strongly indicates that it never existed.

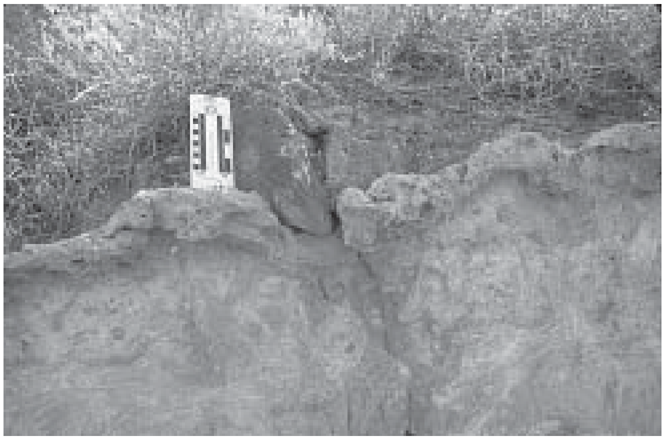

Figure 11. A close-up view of the contact between the Merriam basalt and the Kaibab limestone. The limestone beneath the melted zone is massive with no evidence of a former karstic surface, one or more soil horizons, or plant alteration. This is predicted within the short time frames of the young-Earth Flood framework

activity that would have been present during the glacial periods, we might expect a more weathered Merriam basaltic lava flow than is reported by these geologists.

The Kaibab Limestone— Merriam Basalt Contact

Probably the most interesting stratigraphic contact at Grand Falls is found between the Kaibab carbonates and the overlying basalt lava flow (Figures 10 and 11). This contact represents the end of erosion for the Kaibab limestone and its preservation since the lava covered it. We should expect to observe the effects of 250 Ma years of surface erosion and paleosol development in the Kaibab limestone. Limestone is soluble in naturally occurring acidic conditions. Rainwater is made naturally acidic after passing through the atmosphere and combining with carbon dioxide to form carbonic acid, with a pH around 5.6 (Foster, 2000). Hence, we should expect to witness a well-developed karstic surface on the top of the exposed Kaibab limestone and associated highly developed paleosol soil horizons (see Froede, 1998).

What we found in our study of the area is surprising. Approximately, two to four inches of the top of the Kaibab limestone is fused into solid rock. The Kaibab upper surface does not appear to reflect any karstic influences. Additionally, there is no physical evidence of any former paleosol horizons beneath the volcanically-fused layer. There is no evidence for past plant activity or any disturbance of the shallow subsurface beneath the fused layer. Where is the evidence to support 250 Ma of time as represented by erosion and/or soil development?

Conclusions

A common sense approach to understanding the timing and age of the Merriam lava flow has apparently been challenged by radioisotopic dating. While the lava flow provides every appearance of being recent, age-dates obtained from the lava suggest otherwise. We believe that Duffield (1997) offers the most candid perspective on the age and origin of the Merriam basaltic lava flow stating:

> The dam-building lava flow at Grand Falls erupted from either the cinder cone known as Merriam Crater or a smaller volcano nearby, about 7 miles west of the Little Colorado River. Geologists do not agree on exactly when this eruption occurred, but it may have been several thousands or tens of thousands of years ago.

While we are not able to quantify or qualify the time necessary to create Grand Falls, we are puzzled by the conventional geoscientist's contention that the Little Colorado River has created a more substantial channel in the Kaibab limestone in 50 to 150 thousand years compared to the upgradient Moenkopi sandstone with an age of at least 235 Ma (Figure 1). We would expect a softer sandstone to weather more rapidly and create a drainage channel similar to that observed in the Kaibab limestone downgradient to Grand Falls.

That the surface of the Merriam basaltic lava flow has remained rather "rough and relatively fresh" with "delicate structures preserved on the flow tops" over the course of 50 to 150 thousand years appears to defy the passage of time by lack of evidence of substantial weathering. The flow appears to be of a recent origin by nature of its excellent preservation. This is empirical evidence. Why do uniformitarians force the time issue by adopting inappropriate age-dates? Unfortunately, they are forced to interpret and skew data in an attempt to bolster an archaic, unrealistic, and nonscientific model of Earth history.

Voluminous physical evidence should exist in support of the uniformitarian concept that 250 Ma elapsed between the top of the Kaibab limestone and the bottom of the Merriam lava flow. No credible supportive evidence is present. Perhaps the purported span of time never existed.

Everything that we observed at Grand Falls is consistent with the time frames and changing geologic energy levels expected in support of the young-Earth framework. We were not able to identify anything geologically that demonstrated any credible defense of the uniformitarian assumptions. Additionally, the uniformitarian literature about this site also failed to provide us with any physical evidence necessary for its support. Grand Falls provides testimony to anyone who is willing to acknowledge evidence of recent events that resulted in its creation. Its very existence supports the young-Earth Flood framework of Earth history.

Acknowledgments

The authors thank the many donors to the Creation Research Society Research Fund, interest from which financed a portion of these studies. We are grateful for the continued support we receive from our families. Mr. Jerry Akridge kindly reviewed and commented on a draft of this article. However, mistakes that remain are our own. We give all the glory to our Lord Jesus Christ—Jesus is Lord! Proverbs 3:5–6.

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Letters to the Editor

Evolution Is Lethal Antiscience—Second Reply to Mr. Eric Blievernicht

In his first letter to the editor of June 2002 and his second letter of June 2003, Mr. Blievernicht criticized the McKusick reference on new genetic disorders (McKusick, 1998, Vol. 1, xiii–xviii). He maintained that the world's foremost catalog of new, medically verified, genetic disorders must be wrong because it disagreed with his intuition that there are no new genetic disorders. He left undisputed the fact that the McKusick volumes of the 1960's gathered all known genetic disorders and subsequent catalogs reported the new genetic disorders as they appeared in the medical journals (McKusick, 1998, Vol. 1, xiii–xviii). The process required continual revisions and these were reported with the newly emerging disorders. For example, for January 2002 the report was "83 New Entries, 680 Changed." The New Entries were the new genetic disorders and the Changed were the revisions. The analyses in Evolution is lethal antiscience (Mastropaolo, 2001) were made on the New Entries, the new genetic disorders, the new human mutations. Mr. Blievernicht apparently failed to read the McKusick reference (McKusick, 1998, Vol. 1, xiii–xviii) to learn that new genetic disorders are being continuously recorded and reported as they occur.

Mr. Blievernicht attempted to refute Dr. McKusick's data with Dr. Demick's unreferenced statement that "80–90% of cases have affected individuals in the family tree, but the remaining cases are sporadic—the result of ever increasing numbers of new mutations." (Demick, 1999) Dr. Demick's estimate that 10 to 20% are new genetic disorders confirms the actual data reported by Dr. McKusick for January 2002 above. Of the medical journal reports, 83 were determined new genetic disorders and 680 were changed, or not new. The new disorders were 12% of the old, which is within Dr. Demick's estimated range of 10–20%. Mr. Blievernicht contradicts himself with his own reference because Dr. Demick's estimate confirms Dr. McKusick's data, which in turn confirms the evidence of new genetic disorders and the extinction forecasts reported in Evolution is lethal antiscience and updated in Mastropaolo, 2003, pp. 49–62.

Mr. Blievernicht in his first letter maintained that medical advances have decreased infant death rates and that could explain the rise in the proportion of deaths from birth defects. In my first reply, that was shown to be false because medical advances also diminish birth defect fatalities. Mr. Blievernicht in his second letter maintains that birth defect fatalities like all birth fatalities are decreasing (U.S. Dept Health, 1998). That is true but he neglects to mention that the percent from birth defects continues to rise exponentially and that rise is correlated biologically and statistically with the exponential manifestation of new genetic disorders as reported by McKusick. He also ignores the fact that Darwinian medical practices, like abortion after prenatal genetic testing, are taking a toll that until recently was not counted.

Abortion is the most prevalent homicide in the United States of America. Since 1973 when it became legal, 42,036,175 have been murdered by the mother's surgeon (*Life and Times*, 2002). In 1996, the latest year listed for U.S. Vital Statistics, there were 1,366,000 abortions, 35% of the number of live births, 70 times the number of murders (U.S. Census Bureau, 2001; The World Almanac, 1999, p. 889). One study found that counting aborted children could increase birth defects from 5% to 29%. The 29% was for anencephaly, virtually no brain or skull, which would be a birth defect fatality. These data verify that abortion is indeed a significant interceptor and statistical suppressor of birth defect fatalities after 1973 (Ethan, Canfield, 2002). This was confirmed in a study of abortions after a diagnosis of Down Syndrome (Bell, Rankin, and Donaldson, 2003). Another increasing interception strategy is preimplantation genetic diagnosis prior to in vitro fertilization, then implantation.

If a child dies from birth defects in its first year of life, then it is counted as a birth defect fatality. Infanticide is the most prevalent homicide before the age of seventeen. Infanticide was greatest in the first week with 82% occurring on the day of birth. About 89% of the known killers were female and typically the mother. Here is another homicide, probably ever increasing, probably in the thousands, probably most lethal to newborn children with birth defects, for which it was originally invented, that intercepts the count of birth defect fatalities.

Sever et al. cited a 1989 report that children with birth defects account for 25% to 30% of pediatric hospital admissions. In 2001, it was found that 71.5 percent of children admitted to hospitals had an underlying disorder with a significant genetic component (McCandless, Brunger, Cassidy, 2001). Many of these children will have children with earlier and likely more severe manifestations of their genetic disorders. Thus, genetic disorders may progress from manifestation in adulthood to manifestation during childhood then infancy and thus become birth defect mortalities.

Coordinating the analysis with chromosomal mapping of disorders, mean disorders, the data from the hospitalization of children with underlying genetic disorders, the birth defect mortalities, the interception of fatal mutations before birth, and the interception of birth defect fatalities after birth, then the conservative forecast was that extinction would occur by 2085 with the average number of disorders per person at 585 and each chromosome supersaturated with new disorders. It is difficult to imagine a viable, reproducing individual with 585 genetic disorders. It would seem that far fewer disorders would cause sterility, miscarriages, birth defect mortalities, or childhood genetic defect fatalities. If the progression of genetic disorders causes fatalities before the reproductive years, then the forecast is permanent extinction. Mr. Blievernicht's contrary intuitions and opinions not withstanding, these analyses of the best medical evidence available forecast human extinction by 2085 or sooner (Mastropaolo, 2001; 2003, pp. 53–58).

Wherever these data have been presented, the reactions of evolutionists have ranged from the commission of civil torts and threats of death by stoning to merely demented with rage because evolution is destroyed and Genesis is confirmed. Going backward in time, the population and the genetic disorders progressively decrease until we find the genetically perfect couple, Adam and Eve, in a genetically perfect garden, Eden, where longevity is 900 years. We also find the correlation of the curvilinear decline in post-Flood longevity, from Noah to David (Brown, 2001, p. 272), with the curvilinear incline of new genetic disorders (McKusick, 1998, Vol. 1, xiii–xviii). Uncensored science confirms the Bible and destroys evolution (Mastropaolo, 2001; 2003, pp. 59–61). Were I a devout evolutionist, I too might be demented with rage.

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Creation Models

In a letter to the editor, Ted Aufdemberge (2003) argues that creation scientists should "stop falling for the temptation to try to explain how the earth as a whole and specific places in particular came to have the rock strata they have" (p. 56). He calls such attempts "warped exegetical interpretation" (p. 57), after asserting that "when we scientific creationists attempt to tell the world how He did it we are attempting to glorify ourselves rather then *[sic]* glorifying God" (p. 57). Dr. Aufdemberge's position, if widely adopted, would radically change the nature of creation research. I submit that his position is deeply flawed and must respectfully but utterly disagree with it.

Studies in natural history are, as Reed writes, "mixed questions," and science has much knowledge it can bring to bear on these questions (2003, p. 43). Should we as a creationist community use science to investigate how "specific places in particular came to have the rock strata they have"? The following paragraphs present five biblical reasons that we are in fact obligated to do so; they also show that such analysis, rightly pursued, most definitely brings glory to God.

First, history is ultimately the work of God (see, for instance, Isaiah 45:1–7). According to Psalm 111:2, "The works of the Lord are great, sought out of all them that have pleasure therein." Those who stand in delighted awe at the mighty works of the Lord naturally desire to "seek them out." This desire, according to Scripture, is thus good, proper, and legitimate.

Second, God has graciously given us dominion over creation (Genesis 1:28). Since "the honor of kings is to search out a matter" (Proverbs 25:2), investigations of natural history are an honorable part of our dominion mandate. Secular scientists seek knowledge without regard for the Creator and thus bring glory to themselves; creation scientists, seeking this knowledge in conscious, humble submission to our Creator's command, bring glory not to themselves but to their Lord.

Third, God's servants desire to know and understand His testimonies (Psalm 119:125). A humble search for more complete understanding of, say, the statement that "all the fountains of the great deep [were] broken up" (Gen. 7:11) is a natural and biblically approved pursuit for God's children. Dr. Aufdemberge seems to eschew all such research, using strong language such as "warped exegetical interpretation." Just how these creationists' exegesis qualifies as "warped" is not apparent. What is apparent is that just as archeology can enrich our understanding of the historical accounts in Scripture, so natural science can enrich our understanding of the passages in which the Bible deals with natural history. And the richer our understanding of the diluvian judgment of God, the deeper our reverence for God Himself: "My flesh trembleth for fear of Thee; and I am afraid of Thy judgments" (Psalm 119:120).

Fourth, we are commanded to "prove all things; hold fast that which is good" (I Thessalonians 5:21). The true test of scientific models is whether or not they can effectively account for the empirical and Scriptural data. Creationism itself, like uniformitarianism, is not a model but a presupposition. However, the models built within that presuppositional framework—pursued in obedience to the Scriptural principles already enunciated—must be tested, according to I Thessalonians 5:21. Can the canopy theory provide enough water without unduly raising the surface temperature? Can a single catastrophe produce the observed fossils and rock layers, or must we resort to a model like the CCC? Is it possible to dispose of the heat generated by CPT? All these and other questions must be investigated if we are to be obedient servants of the Lord. The appearance of articles dealing with such questions is thus a positive, not a negative, development.

Finally, the Word of God commands us, "Brethren, be not children in understanding: howbeit in malice be ye children, but in understanding be men" (I Corinthians 14:20). If a lack of interface between our models and empirical data does not bother us—or if we reject model-building altogether—we are in violation of this command. Indeed, if we do not seek detailed understanding of the diluvial strata, we run a grave risk of telling the very sort of "just so" stories which thrive in evolutionary circles. For instance, it is all very well to speak in general terms of hydraulic sorting, but the real question is whether or not diluvial mechanisms can explain these particular strata in this particular location. Dr. Aufdemberge's position, if consistently upheld, would quickly lead us back to the point where the best available theory would be that God created the fossils in situ as tests of our faith. A biblical understanding, on the other hand, realizes that there is "a time to break down and a time to build up" (Ecclesiastes 3:3). Since even before the publication of *The Genesis Flood*, creationists have realized that it is not enough to break down evolutionary models; rather, biblically sound models must be built up in their place. It is only by such complementary activities that we cease from being "children in understanding" and start being men.

In summary, creationary model-building glorifies God by seeking out His works; by exercising our God-given dominion mandate; by exhibiting desire for understanding of His Word; by testing our beliefs, first according to Scripture and then according to the empirical data; and by bringing us farther along the road to a mature understanding. Therefore, every publication of an article that seeks "to explain how the earth as a whole and specific places in particular came to have the rock strata they have" is a welcome, biblical, God-glorifying event that is to be commended and encouraged.

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Lazella M. Lawson*

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	Number			
Volume	**1**	**2**	**3**	**4**
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	Number			
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29	☐	☐	☐	☐
30	☐	☐	☐	☐
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32	☐	☐	☐	☐
33	☐	☐	☐	☐
34	☐	☐	☐	☐
35	☐	☐	☐	☐
36	☐	☐	☐	☐
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Creation Research Society

History—The Creation Research Society was organized in 1963, with Dr. Walter E. Lammerts as first president and editor of a quarterly publication. Initially started as an informal committee of 10 scientists, it has grown rapidly, evidently filling a need for an association devoted to research and publication in the field of scientific creation, with a current membership of over 600 voting members (graduate degrees in science) and about 1000 non-voting members. The Creation Research Society Quarterly has been gradually enlarged and improved and now is recognized as the outstanding publication in the field. In 1996 the CRSQ was joined by the newsletter Creation Matters as a source of information of interest to creationists.

Activities—The society is solely a research and publication society. It does not hold meetings or engage in other promotional activities, and has no affiliation with any other scientific or religious organizations. Its members conduct research on problems related to its purposes, and a research fund is maintained to assist in such projects. Contributions to the research fund for these purposes are tax deductible. As part of its vigorous research and field study programs, the Society operates The Van Andel Creation Research Center in Chino Valley, Arizona.

Membership—Voting membership is limited to scientists who have at least an earned graduate degree in a natural or applied science and subscribe to the Statement of Belief. Sustaining membership is available for those who do not meet the academic criterion for voting membership, but do subscribe to the Statement of Belief.

Statement of Belief—Members of the Creation Research Society, which include research scientists representing various fields of scientific inquiry, are committed to full belief in the Biblical record of creation and early history, and thus to a concept of dynamic special creation (as opposed to evolution) both of the universe and the earth with its complexity of living forms. We propose to re-evaluate science from this viewpoint, and since 1964 have published a quarterly of research articles in this field. All members of the Society subscribe to the following statement of belief:

1. The Bible is the written Word of God, and because it is inspired throughout, all its assertions are historically and scientifically true in all the original autographs. To the student of nature this means that the account of origins in Genesis is a factual presentation of simple historical truths.
2. All basic types of living things, including humans, were made by direct creative acts of God during the Creation Week described in Genesis. Whatever biological changes have occurred since Creation Week have accomplished only changes within the original created kinds.
3. The Great Flood described in Genesis, commonly referred to as the Noachian Flood, was a historical event worldwide in its extent and effect.
4. We are an organization of Christian men and women of science who accept Jesus Christ as our Lord and Savior. The act of the special creation of Adam and Eve as one man and woman and their subsequent fall into sin is the basis for our belief in the necessity of a Savior for all people. Therefore, salvation can come only through accepting Jesus Christ as our Savior.